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SELECTED WATER RESOURCES ABSTRACTS

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JULY 1987

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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W87-05165 -- W87-05921

The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1987.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SUBJECT FIELDS AND GROUPS

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

FACTORS AFFECTING SHORT-TERM VARIABILITY IN SEDIMENT PH AS A FUNCTION OF MARSH ELEVATION IN A VIRGINIA MESOHALINE MARSH,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2L.
W87-05589

2A. General

EFFECT OF ASSUMPTIONS ON MODEL CALIBRATION AND PREDICTION,
Utah Water Research Lab., Logan.
E. K. Israelsen.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 195-201.

Descriptors: *Model studies, *Calibrations, *Predicting, Hydraulic models, Salinity, Path of pollutants, Performance evaluation.

Simulation models have been used for many years to predict the response of dynamic systems to changes in the input parameters. Modeling is also beneficial in developing an understanding of the real system since many changes in the system configuration can be implemented over very short periods of time. Results of the application of simulation models have covered the range from excellent to not very useful. Creation of a hydrosalinity model, requires at least three levels of formulation, namely (1) conceptualization of the real world physical system, (2) mathematical description of the concepts of the real world processes, and (3) computer algorithms which represent the mathematical description of the real world processes. Each of the three levels of model development is subject to assumptions which are not exact replications of the real world. However, the use of assumptions is necessary to specify the model to represent a dynamic system. The effect of assumptions on model calibration is to bias the model so that it conforms to the perceived system organization held by the modeler. The same bias then carries over into all of the predictions made by the model. Prediction tools do not replace understanding of the system in arriving at correct solutions to salinity prediction of prototype systems. If the model is needed to help the modeler understand the system, the system parameter set should not be specified without investigating each possible process configuration. (See also W87-05165) (Lantz-PTT)
W87-05182

COMPARISON OF TWO COMPUTER MODELS FOR PREDICTING SOIL WATER IN A TROPICAL MONSOON CLIMATE,
Universidade Federal de Pernambuco, Recife (Brazil). Centro de Energia Nuclear.
For primary bibliographic entry see Field 2G.
W87-05279

RUNOFF BEHAVIOUR OF WATER HARVESTING MICROCATCHMENTS,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma.
Agricultural Water Management AWMADF, Vol. 11, No. 2, p 137-144, April 1986. 4 fig, 3 tab, 21 ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall, *Runoff, *Water harvesting, *Catchment areas, Loam, India, Slopes, Field tests, Morphology, Arid zone.

The relationship between rainfall and runoff has been observed over a period of 7 years on sandy loam soils of the Indian Arid Zone. Fifteen microcatchment areas (MC) were studied; these were formed by combinations of three slopes (0.5, 5 and 10%) and five lengths (5.12, 7.0, 8.5, 10.75 and 14.5 m) with corresponding areas of 252, 324, 360, 396, and 432 sq m. These MC's can produce 13.3-45.4% runoff depending upon their morphological characteristics. Over the 7-year period, threshold rainfall reduced by half and runoff efficiency doubled due to formation of a less pervious soil crust over the MC surface; it became denser each year. (Author's abstract)
W87-05450

PHYSICALLY-BASED FOREST HYDROLOGY MODEL I: DEVELOPMENT AND SENSITIVITY OF COMPONENTS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W87-05522

PHYSICALLY-BASED FOREST HYDROLOGY MODEL II: EVALUATION UNDER NATURAL CONDITIONS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W87-05523

SOME THEORETICAL AND PRACTICAL ASPECTS OF INFILTRATION IN CLAYS WITH D = CONSTANT,
Ceske Vysoke Uceni Technicke v Praze. Soil Science Lab.
For primary bibliographic entry see Field 2G.
W87-05680

RAINFALL INFILTRATION INTO SWELLING SOILS,
Instituto Nacional de Investigaciones Agrarias, Cordova (Spain).
J. V. Giraldez, and G. Sposito.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 137-141, 2 fig, 5 ref.

Descriptors: *Expansive soils, *Infiltration, *Swelling soils, *Rainfall infiltration, *Soil swelling, *Mathematical studies, *Soil water, Mathematical equations, Richards equation, Soil profiles, Rainfall rate, Permeability coefficient, Ponding, Soil saturation.

A mathematical presentation of water movement through swelling soils, exhibits features different from those observed in rigid soils, mainly due to the presence of the envelope-pressure potential. The governing equation for soil water movement is the generalized Richards equation. Rainfall infiltration can be described by integration of the Richards equation in a soil profile, whose initial water content profile is known, subjected to an external flux condition at the soil surface. This upper boundary condition holds up to the time when the surface water content reaches its maximum value, i.e. the ponding time. After that moment the surface water content remains constant. In general, ponding occurs earlier in swelling than in nonswelling analogous soils. The post-ponding infiltration rates are lower in swelling than in the nonswelling analogous soils. In rigid soils, the ultimate rate of infiltration is equal to the hydraulic conductivity at saturation. In swelling soils, there is ultimately a balance between the gradient of the matric potential and the force associated with gravity and the envelope pressure. As a result, the rate of infiltration will approach zero, and the water content profile approaches the equilibrium profile with free water at the surface. (See also W87-05665) (Lantz-PTT)
W87-05683

INFILTRATION OF WATER INTO CRACKED SOIL,
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
V. Novak, and A. Soltesz.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 148-151, 2 fig, 1 tab, 7 ref.

Descriptors: *Infiltration, *Cracked soil, *Mathematical analysis, Soil water, Soil swelling, Rainfall infiltration, Rainfall rate, Infiltration rate.

An empirical method is for determining the time course of the rate of infiltration into heavy, swelling soils is based on two assumptions: (1) water infiltrates into heavy soils primarily through the cracks, and infiltration through the soil matrix is relatively small; and (2) the geometry of cracks, expressed by the volume fraction of cracks is a function of the water content. The initial water content and precipitation intensity are taken into account. The measurements have shown that the rate of infiltration depends on the volume fraction of cracks, this being a function of the initial water content and the rate of precipitation. (See also W87-05665) (Lantz-PTT)
W87-05685

SEASONAL CHANGES IN SOIL-WATER REDISTRIBUTION PROCESSES AFFECTING DRAIN FLOW,
Birkbeck Coll., London (England). Dept. of Geography.
For primary bibliographic entry see Field 2G.
W87-05687

HYDRAULIC AND HYDROLOGICAL OPERATING OF A FIELD EXPERIMENT IN LORRAINE HEAVY CLAY SOIL OVER A PERIOD OF EIGHT YEARS,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
For primary bibliographic entry see Field 2G.
W87-05693

NEW APPROACHES IN WATER BALANCE COMPUTATIONS,
International Association of Hydrological Sciences.
For primary bibliographic entry see Field 7B.
W87-05726

OVERVIEW ON THE PRESENT STATUS OF THE CONCEPTS OF WATER BALANCE MODELS,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
S. Dyck.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC. 1985. p 3-19, 4 fig, 1 tab, 63 ref.

Descriptors: *Hydrologic budget, *Hydrologic models, *Mathematical models, *Precipitation, *Evapotranspiration, Runoff, Soil water, Groundwater, Snow cover, Vegetation, Spatial distribution, Model studies, Temporal distribution, Hydrologic data collections, Mathematical equations.

Water balance models discussed in the present overview are based on the macroscopic version of the equation of continuity. The various continuous water movement processes of the hydrological cycle are lumped over finite time intervals and areas and related by the water balance equation: precipitation = evapotranspiration + runoff + or - change in storage of water bodies, soil moisture, groundwater and snow cover. Considerable progress was made in the development of conceptual basin models due to the methods developed for computation of both regional evapotranspiration directly from climate data and site evapotranspiration taking into account the spatial variability of the properties of soils and vegetation. The selection of a suitable model depends on the problem to be solved, the pertinent time and space scales, and

the availability of data and data processing facilities. (See also W87-05726) (Author's abstract)
W87-05727

AVAILABILITY OF EVAPORATION DATA IN SPACE AND TIME FOR USE IN WATER BALANCE COMPUTATIONS,
Institute of Hydrology, Wallingford (England).
H. R. Oliver.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the Internationl Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC. 1985. p 21-31, 1 fig, 1 tab, 24 ref.

Descriptors: *Evaporation, *Hydrologic budget, *Hydrologic models, *Hydrologic data collections, *Remote sensing, Lysimeters, Soil moisture meters, Energy, Mathematical models, Mathematical equations, Mathematical studies, Correlation analysis, Meteorological data collection.

Evaporation is the most difficult component of the water balance to determine with any accuracy. Small scale water balance measurements include botanical methods, lysimeter measurements, soil moisture determinations, and use of evaporation tanks. Local area water balance measurements include energy balance methods and eddy correlation analysis. Drainage basin water balance measurements can give a good estimate of the evaporation from a mixed non-uniform area on time scales from weeks to years for areas of a few to thousands of hectares. For all water balance computations, a good measurement of rainfall is required. Rain gages are often used, but it is sometimes possible to use remote sensing devices such as radar. Another process of great hydroloigcal importance is the interception of precipitation by vegetation. Suitable gaging stations are needed to measure the surface water flow from a drainage basin. To extend the measurement of the water balance to cover larger regions, evaporation models are used to calculate the evaporation component. Simple evaporation equations such the the Penman equation and the Priestley-Taylor equation are described along with more complex models and remote sensing methods for the assessment of water balances. For many areas, more direct measurements, more information on the applicability of existing models, and the availability of more ground based or remotely sensed meteorological data are required before the evaporation component of the global water balance can be satisfactorily understood. (See also W87-05726) (Geiger-PTT)
W87-05728

ESTIMATION, AUTOCORRELATION, AND GROUNDWATER DATA IN WATER BALANCE MODELS,
Vrije Univ., Brussels (Belgium).
G. L. Vandewiele.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the Internationl Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC. 1985. p 33-40, 4 fig, 2 ref.

Descriptors: *Hydrologic budget, *Hydrologic models, *Mathematical models, *Groundwater movement, *Correlation analysis, Mathematical studies, Mathematical equations, Evapotranspiration, Runoff, Evaporation, Precipitation, Model testing, Model studies.

Three topics in water balance estimations are illustrated with a simple example. First it is shown how any term of the balance, such as evapotranspiration, direct runoff and storages, can be estimated including confidence regions. Moreover it is shown how one can profit by such estimations for simplifying the model. A second topic concerns autocorrelation. Mostly a water balance model contains a random deviation for taking account of any effect not modelled. Estimation of unknown parameters usually is performed by the least squares method, which is justified by the hypothesis that the above-mentioned deviation is white noise. In most cases residual analysis however shows that this hypothesis is invalid. This paper aims to take account of this effect by the use of ARMA processes instead of white moise as models for the deviations. Thus more realistic parameter values and water balance terms are obtained. This autocorrelation is particularly important when simulating runoff in problems of irrigation and drinking water supply. A third topic takes account of groundwater data. The inputs of a water balance model are precipitation, temperature, evaporation, potential evapotranspiration or other similar quantities. Mostly the output is runoff, and the model is calibrated by comparison of calculated and measured runoff. This paper shows how one can ameliorate model quality by using groundwater data as a supplementary output. The problem of relative precision of runoff and groundwater data is treated. (See also W87-05726) (Author's abstract)
W87-05729

GENERAL REPORT ON WATER BALANCE COMPUTATION TECHNIQUES,
Institute of Hydrology, Wallingford (England).
K. J. Beven, and P. E. O'Connell.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC. 1985., p 41-46, 7 ref.

Descriptors: *Hydrologic budget, *Hydrologic models, *Mathematical equations, *Mathematical models, *Model studies, Mathematical studies, Precipitation, Evapotranspiration, Groundwater recharge, Groundwater storage, Discharge measurement, Stochastic process, Markov process.

Five papers that use different methods to simplify the catchment water balance equation are reviewed. The catchment water balance equation equates precipitation to the sum of discharge, actual evapotranspiration, loss to deep groundwater and the change in storage. The study by Liang assumes the changes in storage to be negligible when calculating evapotranspiration losses. The paper by Saxton gives a useful review of the simulation model approach to predicitng short term changes in the terms of the water balance equations. In this paper the SPAW model is described in some detail along with its application to simulate soil moisture content at different depths over time for the growing season of a corn crop in Iowa, and winter wheat in Washington. Wheater and Sherratt are also concerned with the simulation of short term changes in soil moisture and evapotranspiration. They focus on the development and application of a system for estimating soil moisture deficits and drainage from moisture content data based on identification of a zero flux plane in the profile. In their paper, the DADIS model is proposed to estimate drainage and evaporation zones. Kontur has formulated a water balance based on a stochastic (Markov chain) model. Afouda works from a set of balance equations to formulate a relativistic theory of hydrological systems that also embraces interactions between elementary particles and the evolution of the universe. (See also W87-05726) (Geiger-PTT)
W87-05730

SOIL WATER HYDROLOGY: SIMULATION FOR WATER BALANCE COMPUTATIONS,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
K. E. Saxton.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC., 1985. p 47-59, 3 fig, 1 tab, 45 ref.

Descriptors: *Hydrologic budget, *Hydrologic models, *Soil water, *Simulation analysis, Mathematical models, Mathematical studies, Model studies, Evapotranspiration, Vegetation effects, Soil-water-plant relationships, Evaporation.

Soil moisture occurs as the result of the climatic, crop, and soil processes which impact water on a vegetated landscape. This complex and highly dynamic water supply provides the water upon which the vast majority of the world food supply depends. Most importantly, it is as variable within and between years and location as the variables which determine its occurrence. The physical processes which determine the dynamic state of soil water have been mathematically described and combined into several simulation models in recent years for agricultural and hydrological objectives. These vary in complexity, inputs, and products according to their objective and developers. Several of these models have been applied to the simulation of daily estimates throughout the crop year. The SPAW model developed by the author has been applied to a variety of situations and objectives. This model is briefly described along with several recent trial applications. These results and those of other similar models suggest that simulation models can now be used to integrate existing knowledge with current observations to provide dynamic soil water estimates useful for several important agricultural and hydrological assessment and prediction needs. (See also W87-05726) (Author's abstract)
W87-05731

FIELD VALIDATION OF SOIL MOISTURE MODELS FOR WATER BALANCE ESTIMATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
H. S. Wheater, and D. J. Sherratt.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC., 1985. p 61-74, 6 fig, 10 ref.

Descriptors: *Hydrologic budget, *Soil water, *Hydrologic models, *Data interpretation, *Evaporation, Drainage, Model studies, Mathematical models, Model testing, Error analysis, Mathematical studies, Soil profiles, Soil water potential.

The majority of water balance models are based on a conceptual representation of the soil water profile as one or more layers in which soil water state is defined by a variable deficit of soil water with respect to a reference level of field capacity. Actual evaporation is then calculated with reference to potential evaporation as a function of soil water deficit. Such models have generally been applied without reference to field measurements of soil water state. However, increasing interest is being taken in the use of such measurements for model validation and calibration. Considerable difficulty can be experienced in expressing soil moisture data in the compatible form of soil water deficit because of physical ambiguity in the concept of field capacity. In this paper the interpretation of soil water data for model calibration is discussed. It is shown from field data that conventional interpretation of field capacity can lead to overestimation of actual evaporation and an alternative procedure is suggested. Ideally, this should be based on the combination of soil water potential and water content data. However, water content data alone are more readily available and approximate methods for identification of drainage and evaporation zones from water content data are presented. The errors associated with data interpretation are quantified from field data with respect to evaporation estimation. (See also W87-05726) (Author's abstract)
W87-05732

METHODOLOGICAL BASIS OF WORLD WATER BALANCE INVESTIGATION AND COMPUTATION,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
I. A. Shiklomanov, and A. A. Sokolov.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC., 1985. p 77-92, 4 tab, 18 ref.

Descriptors: *Hydrologic data collections, *Hydrologic budget, *Networks, *International Hydrological Decade, *Available water, Hydrologic cycle, Population dynamics, Water supply, Evaporation, Precipitation, Runoff, Groundwater movement, Sea level, Water resources development.

The USSR National Committee for the International Hydrological Decade (IHD) in cooperation with the IHD National Committees of other countries prepared the monograph 'World Water Balance and Water Resources of the Earth' together with the Atlas. The monograph presents an estimate of the total amount of water and its cycling in all parts of the hydrosphere. Investigations resulted in the evaluation of the water reserves and water availability of the continents and of the earth as a whole for the present time and for the year of 2000 with regard to population growth and economic development. In the course of the studies the data from the world network of hydrological (about 8000), meteorological (over 50000), aerological and marine hydrometeorological stations including weather ships, were collected and collated on a unified methodological basis. The observational data were adjusted for the period 1900-1960. Data from hydrometeorological observations and investigations carried out in the Arctic and Antarctic regions were used which made it possible to calculate for the first time the water balance for the entire planet. The paper describes the methods of estimating secular water reserves, the hydrological cycle elements, water resources and their changes. The results obtained are compared with the data of other authors. (See also W87-05726) (Author's abstract)
W87-05733

APPLICATION OF ENVIRONMENTAL ISOTOPE TECHNIQUES IN WATER BALANCE STUDIES OF SMALL BASINS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
W. Stichler, and A. Herrmann.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC., 1985. p 93-112, 8 fig, 4 tab, 36 ref.

Descriptors: *Hydrologic budget, *Hydrologic models, *Tracers, *Isotopic tracers, *Isotope studies, *Runoff, Hydrographs, Model studies, Mathematical models, Mathematical studies, Hydrologic data collections, Environmental tracers, Catchment areas, Storm runoff, Snowmelt, Tritium, Deuterium, Recharge.

The contribution of environmental isotope techniques to conventional water balance studies is demonstrated by taking several small mountainous basins in Central Europe as examples. Tritium and deuterium or oxygen-18 input and output functions are applied under the caption of hydrograph separation and mean residence time calculation, and with the respective experimental and modelling procedures being explained. Special attention is drawn to the advantages, to hydrological and hydraulic consequences and to the discrimination of subsurface reservoirs from the application of this technique. A model basin water balance established on the basis of hydrological data concludes the specific information from environmental isotopes in water balance computations. (See also W87-05726) (Author's abstract)
W87-05734

GENERAL REPORT ON GLOBAL, REGIONAL, LOCAL WATER BALANCES AND LONG TERM FORECASTS,
Agricultural Univ., Wageningen (Netherlands).
F. C. Zuidema.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC., 1985. p 113-123, 7 fig, 2 tab, 3 ref.

Descriptors: *Hydrologic budget, *Mapping, *Hydrologic data collections, *Hydrologic models, *Mathematical models, Model studies, Catchment areas, Mathematical studies, Diversion, Catchment basins, Forecasting, Runoff, Discharge, Precipitation, Recharge, Evaporation, Drought, Hydrologic cycle.

Summaries are given of 10 papers, two of which concern topics of global and continental water balances, five of which discuss water balances of parts of continents and large countries with emphasis on variations in time and space and on mapping of data, and three of which cover water balances of relatively small areas. Topics of papers on global and continental water balances are: geographical regularities of the world water balance and their use in hydrological calculations for developing countries; and studying water resources of tropics on the basis of zonal regularities of water balance formation. Topics of papers on water balances of parts of continents and large countries are: water balance approach to the study of aridity and droughts with special reference to India; water balance computation in West Africa; water balance regularities in mountain areas of Middle Asia; variations in the water balance of Finland during the last fifty years; and synoptic water balance mapping in Sweden. Topics of papers on water balances of relatively small areas are: a local water balance and the role of anthropogenic factors in its transformation; influence of diversions out of a hydrological basin on its water balance; and effects of land use on the hydrology of small basins in Hessen (FRG). Mapping the water balance elements is stressed in nearly all of the papers. Suggestions for future research include: further quantification of the approach of using computerized mapping by means of isolines of groundwater discharge into rivers and total wetting for Africa; more attention to quantitatively funded water balance studies at local scale with special emphasis to qualitative aspects; and finding a suitable balance between further development of simulation analysis and field studies of water balance in small watersheds. (See also W87-05726) (Geiger-PTT)
W87-05735

WATER BALANCE APPROACH TO THE STUDY OF ARIDITY AND DROUGHTS WITH SPECIAL REFERENCE TO INDIA,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
V. P. Subrahmanyam.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC., 1985. p 125-135, 8 fig, 4 tab, 11 ref.

Descriptors: *Drought, *Hydrologic budget, *Hydrologic models, *India, *Arid-zone hydrology, Arid climates, Arid lands, Arid zone, Deserts, Climatology, Model studies, Water deficit, Water shortage, Monsoons, Hydrologic data collections, Data interpretation, Mapping, Prediction.

Droughts are periods of acute water shortage affecting all human activities in general and agriculture in particular. Aridity on the other hand, describes the climate of a locality which is subject to frequent or continuous droughts. The paper presents the principles and procedures of drought climatology employing the water balance concepts and discusses the climatology of aridity and droughts of the Indian region. Identification and categorization of drought years have been made using Thornthwaite's index of aridity. Year-to-year water balance fluctuations reveal shifts in the normal climatic types of stations and changes in their moisture regimes. A proposed index of drought severity in terms of the intensity and duration of droughts in different years is expected to be of immense practical use in assessing the impact of droughts on agricultural economy. The paper concludes with the concept of drought spread and its utility in desertification studies. (See also W87-05726) (Author's abstract)
W87-05736

SYNOPTIC WATER BALANCE MAPPING IN SWEDEN,
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
S. Bergstrom, and B. Sundqvist.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC. 1985., p 137-145, 6 fig, 2 ref.

Descriptors: *Hydrologic budget, *Sweden, *Mapping, *Hydrologic models, *Runoff, Model studies, Computer models, Hydrologic data collections, Data interpretation, Networks, Soil water, Snowpack, Soil moisture deficiency, Climatology, Meteorological data collection, Forecasting.

The experience of conceptual hydrological modelling at the Swedish Meteorological and Hydrological Institute has made it possible to generalize the parameters of the HBV-runoff model over the country. A computer-based system has been built up where these parameters are used in automatic daily computations of water balance elements for each one of 166 synoptic climate stations. The elements are snowpack, soil moisture deficit and runoff generation. The results are plotted automatically on a digitized map, also showing the main rivers, and are made available for users via the telephone network (TELEFAX). This map provides an instant overview of the hydrological situation with indications of flood risks and other extreme situations. The basis for this mapping technique and some examples from a one-year test period are presented. (See also W87-05726) (Author's abstract)
W87-05737

EFFECTS OF LAND USE ON THE HYDROLOGY OF SMALL BASINS IN HESSEN (FEDERAL REPUBLIC OF GERMANY),
Giessen Univ. (Germany, F.R.). Inst. fuer Mikrobiologie und Landeskultur.
H. Ernstberger, and V. Sokollek.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC., 1985. p 147-157, 6 fig, 3 tab, 11 ref.

Descriptors: *Hydrologic budget, *Hydrologic models, *Soil-water-plant relationships, *Evapotranspiration, *Land use, Soil water, Precipitation, Vegetation, Catchment areas, Soil moisture retention, Root zone, Forest watersheds, Transpiration, Model studies, Agricultural watersheds.

The estimation of areal evapotranspiration (ET) is based upon soil-water balances of single sites with different land use. Correct determination of gross precipitation or throughfall is a prior condition for a usable water balance computation by means of the simple Haude/soil-water balance method. As

for annual actual ET (AET) of different vegetation covers in a wet year (1981) the following sequence was found: spruce, 30 yr (highest AET) > spruce, 15 yr > bushes > meadow = or equivalent to open abandoned land = or equivalent to oats > winter barley > maize (lowest AET). The transfer of calculated point ET values to small basins is mainly carried out by the aid of land-use patterns, since soil properties in each investigated area are rather similar. In a year with nearly normal weather conditions (1979) areal potential ET is higher in the Krofdorf C basin (58% abandoned land, 26% forest) than in the Saubach basin (85% farmland, 13% forest). Since in Krofdorf C the soil is shallow, actual ET is more reduced compared to potential ET than in Saubach, where the soil is deeper. Thus, the actual ET amounts of both basins nearly correspond (1979: approximately 450 mm/yr). (See W87-05726) (Author's abstract)
W87-05738

WATER BALANCE COMPUTATION IN WEST AFRICA: PROBLEMS AND PROSPECTS,
Lagos Univ. (Nigeria). Dept. of Geography.
O. Ojo.
IN: New Approaches in Water Balance Computations, Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC. 1985., p 159-167, 21 ref.

Descriptors: *Hydrologic budget, *Hydrologic models, *West Africa, *Developing countries, *Model studies, Evaporation, Precipitation, Evapotranspiration, Project planning, Mathematical models, Mathematical studies, Hydrologic data collections, Rainfall, Irrigation.

The need to apply the water balance approach in hydrological studies has been realized for the past 20 or 30 years in West Africa in particular and Africa in general. Studies have been carried out on individual components of the water balance equation in order to improve the accuracy of the application of the approach. The greatest emphasis has been placed on rainfall and evapotranspiration, the most important inflow and outflow components of the water balance, respectively. Problems associated with instrumentation, personnel, siting and maintenance of data collection stations for these components are discussed. The first two decades of the introduction of the water balance approach into West Africa witnessed a rapid development in the application and modification of some models developed in the middle latitude countries for computing evaporation and potential evapotranspiration. The application of Thornthwaite's model for calculating evapotranspiration in West Africa is too generalized, particularly on local scales, for example within a crop field. Consequently, its application in planning and development is restricted to inventory and analysis on relatively large regional scales. Penman's approach to predicting evaporation and evapotranspiration provides more accurate results, particularly in its modified forms. There is no agreement as to which of the modified forms, developed in the region, is most acceptable for application to planning. For future developments of the application of the water balance models, local situations and need must be considered. (See also W87-05726) (Geiger-PTT)
W87-05739

LANDFORM MODIFICATIONS AT A NUCLEAR-WASTE BURIAL SITE,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W87-05766

SEDIMENT YIELD OF THREE DRAINAGE BASINS IN GUAM,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2J.
W87-05767

VERIFICATION OF THE PRMS SEDIMENT-DISCHARGE MODEL,
Geological Survey, Harrisburg, PA.
For primary bibliographic entry see Field 2J.
W87-05812

RUNOFF-SEDIMENT YIELD MODEL FOR SEMIARID REGIONS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
For primary bibliographic entry see Field 2J.
W87-05815

SMALL WATERSHED MODEL (SWAM),
Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 7A.
W87-05824

PLOT AND WATERSHED NUTRIENT LOSSES IN THE PALOUSE,
Agricultural Research Service, Pullman, WA.
For primary bibliographic entry see Field 5B.
W87-05832

DERIVATION OF A NEW VARIABLE INSTANTANEOUS UNIT HYDROGRAPH,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
For primary bibliographic entry see Field 2E.
W87-05844

METHODS FOR EVALUATING THE REGIONAL HYDROLOGIC IMPACTS OF GLOBAL CLIMATIC CHANGES,
California Univ., Berkeley. Energy and Resources Group.
For primary bibliographic entry see Field 2B.
W87-05848

NONLINEAR FLOOD FORECASTING BY THE FILTER SEPARATION AR METHOD,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-05852

2B. Precipitation

SELENIUM IN WESTERN ATLANTIC PRECIPITATION,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W87-05257

CORRELATIONS BETWEEN STREAM SULPHATE AND REGIONAL SO2 EMISSIONS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W87-05258

COUNTING THE COSTS OF RAINFALL,
King's Coll., London (England). Dept. of Biology.
P. D. Moore.
Nature NATUAS, Vol. 323, No. 6083, p 14-15, September 1986. 7 ref.

Descriptors: *Precipitation, *Rain, *Nutrients, *Acid rain, Forest, Reforestation, Plant tissues, Leaching, Canopy.

Precipitation brings both benefits and problems to the plant life of an ecosystem both in providing a source of nutrients which may be critically important to the recovery of damaged ecosystems and in damaging plant canopy by either physical impact or leaching which results in decreased productivity, especially if the rain is acidic. There are many well known examples of precipitation acting as a major source of nutrient capital for a growing ecosystem. Considerable quantities of nutrients can also be leached from the canopy of a forest, but rain leaching losses of carbon compounds do not represent a significant portion of primary productivity. The detrimental influence of acid rain on the overall yield of many plants is well established. Water droplets travelling at low to medium velocity can also strip epicuticular wax which can leave plants exposed to pollutant chemicals, pesticides and pathogens. (Michael-PTT)
W87-05260

WEATHER DEPENDENCE OF FORAGE HARVESTING OPERATIONS,
University Coll., Dublin (Ireland). Dept. of Agricultural and Food Engineering.
For primary bibliographic entry see Field 3F.
W87-05278

SYNERGISTIC EFFECTS OF ACID RAIN AND (+ OR -)-2-(2,4-DICHLOROPHENOXY) PROPANOIC ACID (2,4 DP) ON GROWTH, MINERAL CONTENT AND STRESS-INDUCED ETHYLENE IN LETTUCE,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
For primary bibliographic entry see Field 5C.
W87-05310

STRUCTURE, ENERGETICS AND PROPAGATION OF ROTATING CONVECTIVE STORMS. PART II: HELICITY AND STORM STABILIZATION,
Oklahoma Univ., Norman.
D. K. Lilly.
Journal of the Atmospheric Sciences JAHSAK, Vol. 43, No. 2, p 126-140, January 15, 1986. 18 fig, 21 ref. NSF Grant ATM-8300603.

Descriptors: *Storms, *Convective precipitation, *Stability analysis, *Storm propagation, Helicity, Flow patterns, Model studies, Beltrami flow, Weather patterns, Vorticity.

Rotating 'supercell' thunderstorms are shown to be characterized by high helicity, the vector inner product of velocity and vorticity, which may be obtained both from the mean flow in which they are embedded and from buoyance enrichment. Some unique properties of supercell helical flow are described, including a tendency for trajectory rotation to be reversed from parcel vorticity. A simple helical (Beltrami) flow model resembles gross supercell structure and also provides a prediction of storm motion. Evidence that helicity may reduce the energy losses to dissipation is presented. The structure and propagation for optimizing the helicity effect was found to be similar to that suitable for augmenting the updraft strength, that is, with the vortices coincident with the updrafts and both propagating laterally to the mean flow hodograph. An additional constraint on storm configuration and propagation not mentioned previously is the maintenance of correlation between vertical velocity and buoyancy. The Beltrami flow solution does not consider buoyancy and does not provide a correct steady state solution to the buoyancy equation. Observational and simulation evidence indicates that long-lived isolated storms usually propagate laterally to the hodograph and have nearly coincident updraft and vortex centers. A final point relates to the stability of Beltrami flows. Even though net nonlinear interactions are cancelled in these flows, there is no proof that the flows are stable to nonhelical disturbances, and in some cases they appear to be highly unstable. For a mean shear flow with a rotating hodograph, all velocity components have sinusoidal profiles, and each point along the hodograph is a point of inflection for disturbances whose wave fronts lie parallel to the local mean wind vector. Linear instability appears to be present everywhere, even in the absence of buoyance, and can be relieved most rapidly by nonhelical disturbances with wave fronts normal to the shear, and the evident stability of strongly helical flows remains inadequately explained. (Lantz-PTT)
W87-05320

COMPARISON OF SHALLOW WATER MODEL RESULTS FOR THREE ESTIMATES OF A COMPOSITE EL NINO FORCING,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2L.
W87-05321

EARLY ELECTRIFICATION AND PRECIPITATION DEVELOPMENT IN A SMALL, ISOLATED MONTANA CUMULONIMBUS,
National Center for Atmospheric Research, Boulder, CO.
J. E. Dye, J. J. Jones, W. P. Winn, T. A. Cerni, and B. Gardiner.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 1, p 1231-1247, January 1986. 15 fig, 2 tab, 34 ref. NSF Grants ATM-8026059, ATM-8211134, ATM-8020415, ATM-8209684; BuRec Contracts 7-07-83-V001, 9-07085-V0026; Office of Naval Research Contract N 000-14-80-C-0258.

Descriptors: *Clouds, *Cloud physics, *Precipitation, *Montana, *Electrical properties, *Thunderstorms, Weather, Climatology, Storms, Radar, Ice, Geophysics, Atmospheric physics, Remote sensing, Updrafts, Charge transfer.

Instrumented aircraft and radar were used to investigate the microphysical, electrical, and dynamic evolution of the life cycle of a small thunderstorm in southeastern Montana. The largest particles and the primary development of precipitation occurred in the fringes of the updraft. The electric fields inside the cloud did not exceed 100 V/m until 5 mm graupel, ice particle concentrations of 10/L, and reflectivities of 35 dBZ were already present, but then rapidly electrified to produce a single intracloud discharge 8 min later, near the peak of microphysical development. Early in the electrical development of the cloud, electric fields were only 200 V/m; negative charge accumulation was near the 7 km level associated with the high reflectivity region. In the early stages of precipitation fallout, particle charge measurements near 4.5 km showed primarily negatively charged particles associated with precipitation falling from the cloud. Less than 10% of the observed particles larger than 100 microns were carrying charges larger than 5 pC, the detection limit of the instrument. These observations are discussed from the point of view of charge generation in thunderstorms, particularly charge transfer between colliding ice particles. (Author's abstract)
W87-05339

POSSIBLE ROLE OF NO3 IN THE NIGHTTIME CHEMISTRY OF A CLOUD,
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
For primary bibliographic entry see Field 5B.
W87-05341

LONG-RANGE TRANSPORT AND DEPOSITION OF ACIDIC NITROGEN SPECIES IN NORTH-WEST EUROPE,
UKAEA Atomic Energy Research Establishment, Harwell (England). Modelling and Assessments Group.
For primary bibliographic entry see Field 5B.
W87-05352

IT NEVER RAINS BUT IT DRIZZLES,
Flinders Univ. of South Australia, Bedford Park.
A. H. Gordon.
Weather WTHRAL, Vol. 41, No. 11, p 349-353, November 1986. 1 fig, 3 tab, 3 ref.

Descriptors: *Rainfall, *Rainfall rate, *Flood control, *Runoff, *Rainfall intensity, *Depth-area-duration analysis, Floods, Flash floods, Rainfall, Thunderstorms, Rainstorms, Rain gages, Precipitation intensity, Precipitation rate, Hydrology, Australia, Weather.

Rainfall rates and cumulative amounts within time intervals of six minutes were analyzed at three stations in South Australia. In most of the six-minute intervals, the rainfall intensity was found to be only 2 mm per hour, with between 15 and 20% of cases falling at the rate of 4 mm per hour during each interval. The distribution of frequencies of total amounts which fall at a given rate in mm per hour is similar, but more widely spread. It is concluded that rain falls at a slow rate most of the time. (Doria-PTT)
W87-05353

MESOSCALE ANALYSES OF THE SICHUAN FLOOD CATASTROPHE, 11-15 JULY 1981,
National Center for Atmospheric Research, Boulder, CO.
Y.-H. Kuo, L. Cheng, and R. A. Anthes.
Monthly Weather Review MRWEAB, Vol. 114, No. 11, p 1984-2003, November 1986. 19 fig, 28 ref.

Descriptors: *Floods, *China, *Disasters, *Weather, *Climatology, Monsoons, Wind, Vortices, Hydrologic budget, Heat budget, Convection.

On July 11-15, 1981, heavy rainfall over the Sichuan basin in China resulted in severe floods. Mesoscale analyses show that the flood was directly related to the extreme development of a long-lived mesoscale vortex (SW vortex) over the basin as it merged with another mesoscale vortex generated over the Tibetan Plateau. Mesoscale heat and moisture budgets suggest that the latent heat release associated with cumulus convection contributed substantially to the development of the SW vortex. Moisture flux analyses and isentropic trajectories indicate that the major moisture source for the flood was from the Bay of Bengal, transported over (and around) the southeastern corner of the Tibetan Plateau to the basin. It is hypothesized that the formation of the SW vortex was a consequence of the blocking of the southwesterly monsoon flow by the mesoscale mountain range at the southeastern corner of the Tibetan Plateau. This is suggested by the fact that the SW vortex was initiated completely within this southwesterly monsoon current, that it was strongest at the lower levels during its formation stage, and that the low-level cyclonic vorticity was present throughout the period that the southwesterly monsoon flowed around the plateau. (Author's abstract)
W87-05388

CONVECTION ALONG THE COAST OF NORTHERN PERU DURING 1983: SPATIAL AND TEMPORAL VARIATION OF CLOUDS AND RAINFALL,
Scripps Institution of Oceanography, La Jolla, CA. Climate Research Group.
J. D. Horel, and A. G. Cornejo-Garrido.
Monthly Weather Review MRWEAB, Vol. 114, No. 11, p 2091-2105, November 1986. 14 fig, 2 tab, 62 ref.

Descriptors: *Convection, *Peru, *Coasts, *Spatial distribution, *Temporal distribution, *Clouds, *Rainfall, *Weather, Distribution, Climatology, Infrared imagery, Satellite technology, Rainfall distribution, Temperature, Water temperature, Wind, Diurnal variation, Flooding.

Flooding in northern Peru was more severe during 1983 than during any year since 1891. A case study of the meteorological conditions along the northwest coast of South America from 10 degrees S to 10 degrees N during 1982-83 is presented based on station rainfall and satellite-derived outgoing infrared observations. In northern Peru, the onset of the rains along the coastal plain was delayed until January 1983 and ended abruptly during mid-June 1983. Convective activity was much greater along the coastal strip than over the eastern equatorial Pacific to the east of 100 degrees W until May-June 1983. In addition, cloudiness was strongly modulated on the diurnal time scale, with more clouds during the night and early morning than during the afternoon. The distribution of rainfall along the Peruvian littoral is compared to local changes in sea surface temperature, surface equivalent potential temperature, and surface wind, suggesting that abnormally high coastal ocean temperatures during the first half of 1983 aided the outbreak of convection during this period. However, the latitudinal extent and timing of the rainfall was quite different from that of sea surface temperature or surface equivalent potential temperature. (Author's abstract)
W87-05389

SHORT-TERM NUMERICAL PRECIPITATION FORECASTS INITIALIZED USING A DIAGNOSED DIVERGENT-WIND COMPONENT,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
E. M. Salmon, and T. T. Warner.
Monthly Weather Review MRWEAB, Vol. 114, No. 11, p 2122-2132, November 1986. 8 fig, 23 ref.

Descriptors: *Precipitation, *Weather forecasting, *Wind, *Model studies, *Meteorology, *Rainfall distribution, *Rainfall rate, *Model testing, Simulation, Rainfall, Prediction, Distribution, Temporal distribution, Mathematical equations, Mathematical analysis, Statistical analysis, Forecasting,.

Very short-range forecast skill has become an important criterion for evaluating the adequacy of model initializations. A mesoscale initialization in which horizontal divergence is diagnosed from a diabatic omega equation was tested on a heavy rainfall case. The procedure for diagnosing the divergent-wind component included effects of latent heating obtained from the observed rain rates. Six-hour rainfall predictions initialized with the diagnosed divergence were compared to observed precipitation and to rainfall forecasts based on initial conditions containing no divergence and observed divergence obtained from the standard rawinsonde winds. The utilization of the mesoscale rainfall information in diagnosing the initial divergent component was found to be important in correctly predicting hourly rainfall patterns, especially for the first few hours. The use of the divergence field obtained from rawinsonde data was only marginally better than the use of nondivergent initial conditions. A data-simulation procedure was also used to test this initialization technique. Results using model-generated data were consistent with those that used real data. Only the diagnosed-divergence initialization produced reasonable rain rates during the first 4-6 hours, and it did so only when the observed rain rates at the initial time were used to define the diabatic term in the omega equation. (Author's abstract)
W87-05390

USING HOUGH HARMONICS TO VALIDATE AND ASSESS NONLINEAR SHALLOW-WATER MODELS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Matematica.
D. P. Dee, and A. M. da Silva.
Monthly Weather Review MRWEAB, Vol. 114, No. 11, p 2191-2196, November 1986. 5 fig, 1 tab, 13 ref.

Descriptors: *Hough harmonics, *Model testing, *Model studies, *Shallow water, *Climatology, *Meteorology, *Waves, *Nonlinear programming, *Mathematical models, Mathematical studies, Flow, Differential equations, Computer programs.

The implementation of a technique for locating programming errors in shallow-water codes, establishing the correctness of the code, and assessing the performance of the numerical model under various flow conditions is described. The right-hand side of the differential equations is modified in such a way that the exact solution of the nonlinear initial-value problem is known, so that the truncation error of the numerical scheme can be studied in detail. The exact solution is prescribed to be any linear combination of Hough harmonics which propogate in time according to their natural frequencies. (Author's abstract)
W87-05391

GLOBAL CLIMATE FOR JUNE-AUGUST 1985: UNUSUALLY DRY IN SEVERAL REGIONS,
National Weather Service, Washington, DC. Climate Analysis Center.
K. H. Bergman, and E. A. O'Lenic.
Monthly Weather Review MRWEAB, Vol. 114, No. 11, p 2333-2354, November 1986. 31 fig, 2 tab,

13 ref.

Descriptors: *Climatology, *Drought, *Weather, *Rainfall, *Seasonal distribution, *Precipitation, Monsoons, Tropical regions, Distribution, Monthly distribution, Temperature, Water temperature, Physical properties, Atmosphere, Atmospheric physics, Ice, Sea ice, Marine climates.

Global climate is reviewed for June-August 1985. The most noteworthy feature of the season was the existence of abnormally dry conditions in several regions. The monsoonal rains of the African sahel, India, and China were comparatively deficient. The first stages of a disastrous drought began in southern Brazil and Paraguay. The winter rains of central Chile were much below normal during the three normally wettest months. Drought conditions developed in parts of the Balkan countries and Japan, and drought persisted in the East Coast of the United States and adjacent southern Canada until August rains brought partial relief. The article discusses: (1) the seasonal climate of the tropical zone, especially the Pacific sector and monsoon regions; (2) the circulation and climate of the Southern Hemisphere extratropics and of the Northern extratropics; and (3) the summer climate of the United States. (Author's abstract)
W87-05392

LOW-ORDER MODEL FOR MOIST CONVECTION,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
X.-Y. Huang, and E. Kallen.
Tellus TELLAL, Vol. 38A, No. 5, p 381-396, October 1986. 8 fig, 14 ref, 3 append. NFR Contracts S-FO 1705-107 and G-GU 1705-106.

Descriptors: *Model studies, *Meteorology, *Convection, *Moist convection, *Temperature effects, *Condensation, *Rainfall, *Mathematical models, Flow fields, Dissipation, Hysteresis, Sensitivity analysis, Convection.

Moist convection is a very common phenomenon in the atmosphere ranging from small scale cumulus to severe thunderstorm complexes. In large-scale models of the atmosphere, these processes have to be parameterized because their scale is too small to be resolved by the models. The parameterization of these effects must be based on properties of nonhydrostatic models while most of the large-scale models rely on the hydrostatic assumption. Two-dimensional, moist convection is modelled with a low-order, spectral model. Heating effects of condensation are taken into account and in particular the vertical asymmetry of the heating field is considered. Due to the interaction between the flow field and the condensational heating, hysteretic effects arise. The sensitivity of the model results to uncertain parameters like the dissipation is investigated. For an atmospherically realistic range of parameter values, it is found that the hysteretic behavior is a robust model property. (Alexander-PTT)
W87-05403

CLOUD CLIMATOLOGY FOR THE SOUTH ATLANTIC DERIVED FROM METEOSAT I IMAGES,
Hamburg Univ. (Germany, F.R.). Meteorology Inst.
For primary bibliographic entry see Field 7B.
W87-05404

MEASUREMENTS OF THE CHEMICAL COMPOSITION OF CLOUDWATER AT A CLEAN AIR SITE IN CENTRAL SCANDINAVIA,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 5A.
W87-05405

REMOVAL OF SOLUBLE SPECIES BY WARM STRATIFORM CLOUDS,
Georgia Inst. of Tech., Atlanta. School of Physical Sciences.
For primary bibliographic entry see Field 5B.
W87-05407

COMPOSITION, DISTRIBUTION AND NEUTRALIZATION OF ACID RAIN DERIVED FROM MASAYA VOLCANO, NICARAGUA,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W87-05408

ESTIMATES OF THE SULFATE SCAVENGING COEFFICIENT FROM SEQUENTIAL PRECIPITATION SAMPLES ON LONG ISLAND,
State Univ. of New York at Stony Brook. Lab. for Planetary Atmospheres Research.
For primary bibliographic entry see Field 5B.
W87-05409

MEASUREMENT OF FORCE VS. TIME RELATIONS FOR WATERDROP IMPACT,
For primary bibliographic entry see Field 2J.
W87-05417

EFFECT OF SOIL SURFACE SEALING ON SPLASH FROM A SINGLE WATERDROP,
For primary bibliographic entry see Field 2J.
W87-05418

RUNOFF BEHAVIOUR OF WATER HARVESTING MICROCATCHMENTS,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2A.
W87-05450

ACID PRECIPITATION EFFECT ON ANION TRANSPORT OF THE ATKINS RESERVOIR, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-05504

STOCHASTIC IMPACTS ON FARMING: III. SIMULATION OF SEASONAL VARIATION OF CLIMATIC RISK,
Agricultural Research Service, Watkinsville, GA.
For primary bibliographic entry see Field 3F.
W87-05530

TRAJECTORY ANALYSIS OF ACID DEPOSITION DATA FROM THE NEW JERSEY PINE BARRENS,
Washington State Univ., Pullman. Program in Environmental Science and Regional Planning.
For primary bibliographic entry see Field 5B.
W87-05540

GAS-PHASE REACTION OF THE METHYLPEROXY RADICAL WITH SULPHUR DIOXIDE,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 2K.
W87-05541

ATMOSPHERIC DEPOSITION OF TOXAPHENE TO EASTERN NORTH AMERICA DERIVED FROM PEAT ACCUMULATION,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5B.
W87-05542

SOCIAL BURDEN OF WEATHER AND CLIMATE HAZARDS,
Colorado Univ. at Boulder. Natural Hazards Research and Applications Information Center.
For primary bibliographic entry see Field 6C.
W87-05546

FUTURE OF LABORATORY RESEARCH AND FACILITIES FOR CLOUD PHYSICS AND CLOUD CHEMISTRY,
Toronto Univ. (Ontario). Dept. of Physics.
R. List, J. Hallett, J. Warner, and R. Reinking.
Bulletin of the American Meterological Society BAMIAT, Vol. 67, No. 11, p 1389-1397, November 1986. 12 fig, 2 tab, 5 ref.

Descriptors: *Cloud physics, *Chemistry of precipitation, *Atmosphere, *Research facilities, Laboratory research.

A technical workshop was held in Boulder, Colorado, on 20-22 March 1985, to review areas and goals of laboratory research in cloud physics and cloud chemistry, defined the basic and practical utility of such research in terms of past accomplishments and future potential, assess the status and needs for existing and new facilities, and recommend future direction for laboratory research and corresponding facilities development in the disciplines of atmospheric science affected by cloud processes. The findings are reported here. Laboratory research in cloud physics and cloud chemistry has been a very productive and necessary complement to field and modeling studies. A high potential for fundamental and significant benefits to a wide range of the atmospheric sciences remains, and these benefits can be realized only through upgrades in existing facilities and, particularly, through development of new facilities with specific and important new capabilities. (Author's abstract)
W87-05547

EUROPEAN WEATHER RADAR: A TOOL FOR UK WATER RESOURCES MANAGEMENT,
For primary bibliographic entry see Field 7B.
W87-05560

RAIN - THE RAW MATERIAL: WAYS TO MEASURE, MODEL AND MANAGE IT,
Department of Housing and Urban Development, Washington, DC.
R. A. Bailey, and J. S. Waters.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 40, No. 5, p 428-436, October 1986. 3 fig, 1 tab, 20 ref.

Descriptors: *Rain, *Drought, *Runoff forecasting, *Rainfall-runoff relationships, Rain gages, Snowmelt, Reservoir storage, River flow.

Problems associated with rain and river discharge prediction as they are faced by the Severn-Trent Water Authority (England) are described under the following headings: rain measurements 1966 to 1986 (purposes of measurement, equipment, snowfall and snowmelt); rain in excess (raingauge alarms, managing floods, modelling runoff from rain and snow, modelling with forecast rain, radar); and rain in drought (defining an exceptional shortage of rain, managing reservoir storage and low river flows, simulation of past droughts). (Rochester-PTT)
W87-05561

LOW-FREQUENCY INTERACTIONS BETWEEN THE SUMMER MONSOON AND THE NORTHERN HEMISPHERE WESTERLIES,
Tsukuba Univ. (Japan). Inst. of Geoscience.
T. Yasunari.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 64, No. 5, p 693-708, October 1986. 10 fig, 37 ref.

Descriptors: *Correlations, *Monsoons, *Westerlies, *India, *Climatology, Mathematical analysis, Heat, Winds.

Inter-correlations between the active/break cycles of Indian summer monsoon and the circulation change in the northern middle and high latitude westerlies were investigated in relation to the low frequency (30-50 day) mode. Empirical orthogonal functions and composite analysis revealed the standing-type east-west oscillations of the geopotential height field between central and far-east

Asia with a node over Tibet. Lag-correlations between the monsoon trough and the 500 mb heights in the northern hemisphere suggest that this east-west oscillation is part of the response of the mid-latitude westerlies to the northward-moving monsoon heat source. The response in the higher latitudes seems to reach its maximum when the heat source approaches the southern periphery of the westerlies, i.e., near the break phase of the monsoon. A plausible mechanism of this interaction between the monsoon and the westerly flow in the higher latitudes is briefly discussed. (Author's abstract)
W87-05587

ORGANIC SUBSTANCES IN THE RAINFALL OF LAKE SUPERIOR: 1983,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5A.
W87-05624

EFFECT OF SIMULATED ACID RAIN ON GROWTH AND YIELD OF VALENCIA ORANGE, FLORADADE TOMATO AND SLASH PINE IN FLORIDA,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5C.
W87-05647

METHODS FOR EVALUATING THE REGIONAL HYDROLOGIC IMPACTS OF GLOBAL CLIMATIC CHANGES,
California Univ., Berkeley. Energy and Resources Group.
P. H. Gleick.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 97-116, November 1986. 2 fig, 2 tab, 55 ref.

Descriptors: *Climatology, *Hydrologic equations, *Mathematical models, *Regional analysis, Hydrologic cycle, Weather.

Concern over changes in global climate caused by rising atmospheric concentrations of carbon dioxide and other trace gases has increased in recent years as our understanding of atmospheric dynamics and global climatic systems has improved. Despite this, many of the effects of human induced climatic changes are still poorly understood. The most profound effect of such climatic changes may be major alterations in regional hydrologic cycles and changes in regional water availability. Unfortunately, these are among the least well understood impacts. This paper reviews approaches for evaluating the regional hydrologic impacts of global climatic changes and presents a series of criteria for choosing among the different methods. One approach, the use of modified water balance models, appears to offer significant advantages over other methods in accuracy, flexibility, and ease of use. Water balance models are especially useful for identifying the regional hydrologic consequences of changes in temperature, precipitation and other climatic variables. The ability of water balance models to incorporate month to month or seasonal variations in climate, snowfall and snowmelt algorithms, groundwater fluctuations, soil moisture characteristics, and natural climatic variability makes them especially attractive for water resource studies of climatic changes. Furthermore, such methods can be combined with state of the art information from general circulation models of the climate and with plausible hypothetical climate change scenarios to generate information on the water resource implications of future climatic changes. (Author's abstract)
W87-05848

2C. Snow, Ice, and Frost

THERMALLY FORCED CIRCULATION IN A SMALL, ICE-COVERED LAKE,
Goeteborg Univ. (Sweden). Oceanografiska Institutionen.
For primary bibliographic entry see Field 2H.
W87-05311

CHARACTERISTICS OF SURGE-TYPE GLACIERS,
British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.
G. K. C. Clarke, J. P. Schmok, C. S. L. Ommanney, and S. G. Collins.
Journal of Geophysical Research (B) JJGBDU, Vol. 91, No. 7, p 7165-7180, June 1986. 6 fig, 6 tab, 42 ref.

Descriptors: *Glaciers, *Surges, *Glacier surges, Distribution, Spatial distribution, Temporal distribution, Ice, Ice sheets, Flow, Yukon, Catchment areas, Glacier flow.

The population statistics of 2,356 glaciers in the St. Elias Mountains of the Yukon were examined; 151 of them (6.4%) were found to be surge-type. A pronounced spatial variation was found in the concentration of surge-type glaciers in the 55 drainage basins analyzed, but no obvious environmental control was evinced. Analysis of the influence of length on surge tendency reveals that long glaciers have a significantly greater probability of being surge-type than do short glaciers. The surge probability increases monotonically from 0.61% for very short glaciers (0-1 km) to 65.1% for long glaciers (10-75km), suggesting that ice sheets and ice caps should have a high probability of surging. Surge-type glaciers tend to have a higher overall elevation than normal glaciers. There is no significant difference between the overall slopes of surge-type and normal glaciers, although there is a tendency for surge-type glaciers to have greater slope in the accumulation zone and lesser slope in the ablation zone. Although prevalent flow direction in the Yukon is north, surge-type glaciers tend to flow east and southeast; this is probably explained by the fact that many of the longest glaciers also flow to the east and southeast. (Author's abstract)
W87-05338

RELATIVE CONTRIBUTIONS OF TROPOSPHERIC AND STRATOSPHERIC SOURCES TO NITRATE IN ANTARCTIC SNOW,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 5B.
W87-05406

FLUORESCENCE INDUCTION AND PHOTOSYNTHETIC RESPONSES OF ARCTIC ICE ALGAE TO SAMPLE TREATMENT AND SALINITY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 2H.
W87-05477

LABORATORY STUDY OF SEDIMENT TRANSPORT UNDER ICE,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2J.
W87-05778

2D. Evaporation and Transpiration

TEMPERATURE AND LEAF OSMOTIC POTENTIAL AS FACTORS IN THE ACCLIMATION OF PHOTOSYNTHESIS TO HIGH TEMPERATURE IN DESERT PLANTS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
For primary bibliographic entry see Field 2I.
W87-05317

PROLINE ACCUMULATION AND THE ADAPTATION OF CULTURED PLANT CELLS TO WATER STRESS,
Purdue Univ., Lafayette, IN. Dept. of Horticulture.
S. Handa, A. K. Handa, P. M. Hasegawa, and R. A. Bressan.
Plant Physiology PLPHAY, Vol. 80, No. 4, p 938-945, April 1986. 7 fig, 2 tab, 39 ref. Binational Agricultural Research and Development Grant US-239-80.

Descriptors: *Plant growth, *Water stress, *Osmotic potential, *Tomatoes, *Plant physiology, *Proline, Tolerance, Amino acids, Stress, Accumulation, Turgor.

The transfer of cultured tomato cells (Lycopersican esculentum cv VENT-Cherry) to a low water potential environment resulted in an increased dry weight to fresh weight ratio accompanied by a rapid accumulation of pro-line. Proline content continued to increase as osmotic adjustment and growth occured. The initial increase in proline concentration was accompanied by a drop in turgor. However, proline levels continued to increase with a gain in turgor during osmotic adjustment. Thus, the accumulation of proline depended not only on cell water potential, or on the initial loss of turgor but more closely on cell osmotic potential. The ultimate level of proline depended on the level of adaptation. Proline levels remained high after more than 100 cell generations in low water potential media, but declined rapidly after transfer to media with less negative water potential. Addition of exogenous proline to the medium during the water stress and during osmotic downshock alleviated the normally resulting inhibition of growth. The results suggest a positive role for proline accumulation in adaptation of cells to changing external water potential. (Author's abstract)
W87-05318

DROUGHT AVOIDANCE STRATEGY IN CERATONIA SILIQUA L., A MESOMORPHIC-LEAVED TREE IN THE XERIC MEDITERRANEAN AREA,
Messina Univ. (Italy). Ist. di Botanica.
M. A. Lo Gullo, S. Salleo, and R. Rosso.
Annals of Botany ANBOA4, Vol. 58, No. 5, p 745-756, November 1986. 4 fig, 1 tab, 31 ref.

Descriptors: *Plant water potential, *Drought resistance, *Water stress, *Carob, *Water potentials, *Plant physiology, *Water loss, Trees, Stress, Leaves, Growth, Transpiration, Sclerophylly, Turgor.

Measurements are reported of diurnal changes in leaf relative water content (RWC), water potential (psi sub l), and conductance to water vapor (C sub wv) during leaf ontogeny in Ceratonia siliqua, an evergreen broad-leafed tree with mesomorphic leaves occurring in a thermophilic plant community in Sicily. Mature leaves appear to withstand water stress by a water spending strategy, losing water substantially during the day but maintaining their RWC at a constant level. This was achieved by dropping psi sub l for minimal water losses, which in turn was due to a substantial and transient drop in turgor pressure. The bulk modulus of elasticity of mature leaves was about 29 MPa. The concept of sclerophylly is discussed in terms of the different functional significance of leaf 'rigidity' as due to a large number of mechanical cells in the mesophyll or to more rigid cell walls of parenchymatous cells. Young leaves of C. siliqua appeared to be potentially very vulnerable to water stress but escape drought because leaf growth is completed before the dry period begins. (Author's abstract)
W87-05342

CANOPY TEMPERATURE BASED IRRIGATION SCHEDULING INDICES FOR KENTUCKY BLUEGRASS TURF,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W87-05432

IRRIGATION SCHEDULING EFFECTS ON YIELD AND PHOSPHORUS UPTAKE OF COWPEA,
Ministry of Agriculture, Jos (Nigeria).
For primary bibliographic entry see Field 3F.
W87-05439

WATER REQUIREMENT FOR IRRIGATED RICE IN A SEMI-ARID REGION IN WEST AFRICA,
Agricultural Univ., Wageningen (Netherlands). Dept. of Civil Engineering and Irrigation.
For primary bibliographic entry see Field 3F.
W87-05446

WATER BALANCE AND PATTERN OF SOIL WATER UPTAKE IN A PEACH ORCHARD,
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
E. Garnier, A. Berger, and S. Rambal.
Agricultural Water Management AWMADF, Vol. 11, No. 2, p 145-158, April 1986. 4 fig, 4 tab, 31 ref.

Descriptors: *Evapotranspiration, *Soil water, *Peaches, *Irrigation, *Water stress, Moisture meters, Soil moisture meters, Field tests, Hydrologic budget, Soil profiles, Trees, Roots, Fruit crops, Orchards, Accumulation, Estimating, Drainage.

Five-year-old peach trees were irrigated at 50% and 100% of calculated maximum evapotranspiration (MET) in order to determine the influence of water stress on the pattern of water uptake from the soil and on the actual evapotranspiration (AET) of the crop. A simplified water balance method based on the relationship between the drainage component and the soil water content averaged over the soil profile was used to estimate AET from periodic neutron probe measurements. Maximum water uptake is from the upper 60 cm of soil when trees are well-watered. Decreased soil water content induces a shift in the soil water uptake towards deeper layers, which can be due either to upward fluxes of water or to an increased water uptake by deeper roots. AET in the 50% MET regime is reduced from July to September, compared to the 100% MET regime, partly because of stomatal closure. There is no drainage in the 50% MET treatment from June to September; it is about 1 mm/day in the 100% MET regime until the end of August and ceases in September when the soil dries. (Author's abstract)
W87-05451

WATER PRODUCTION FUNCTION OF SORGHUM FOR NORTHEAST BRAZIL,
Inter-American Inst. for Cooperation on Agriculture, Petrolina (Brazil).
For primary bibliographic entry see Field 3F.
W87-05453

EVAPORATION-DRIVEN SALINITY MAXIMUM ZONE IN AUSTRALIAN TROPICAL ESTUARIES,
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2L.
W87-05485

EFFECTS OF FREQUENCY OF IRRIGATION AND GYPSUM TREATMENT ON LEAF WATER POTENTIAL AND LEAF STOMATAL CONDUCTANCE OF LUCERNE (MEDICAGO SATIVA L.) GROWN ON A HEAVY CLAY SOIL,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 3F.
W87-05505

EFFECT OF SOIL MOISTURE STRESS ON LEAF AREA INDEX, EVAPOTRANSPIRATION AND MODELED SOIL EVAPORATION AND TRANSPIRATION,
New Mexico State Univ., Las Cruces. Dept. of Mathematical Sciences.
T. W. Sammis, S. Williams, D. Smeal, and C. E. Kallsen.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 956-961, July-August 1986. 3 fig, 4 tab, 15 ref. DOI Project C-90229.

Descriptors: *Soil moisture deficiency, *Leaf area index, *Evapotranspiration, *Model studies, *Soil evaporation, *Transpiration, Irrigation scheduling, Wheat, Barley, Crop yield, Prediction, Soil types.

Leaf area index (L) development of a crop decreases with increased soil moisture stress. This affects the amount of soil evaporation that occurs through the growing season. Leaf area index of winter wheat (Triticum aestivum L.) and spring barley (Hordeum volgare L.) were measured during the growing season on plots receiving different irrigation levels to develop a functional model to predict L under soil moisture stress and non-soil-moisture-stress conditions based on measurement of evapotranspiration or modeled transpiration. The wheat study was conducted for 2 years on Pullman clay loam (fine-loamy, mixed, thermic Torrertic Paleustoll). The barley study was conducted for 1 year on a Wall sandy loam (Typic Camborthid, coarse, loamy, mixed, calcareous, Mesic family). Leaf area index was linearly related to cumulative evapotranspiration (E sub tcum) up to maximum L. The wheat and barley functions relating relative L (L/L sub max)) to relative cumulative evapotranspiration (E sub tcum/E sub tcumm where E sub tcumm = E sub tcum at L sub m) up to maximum L where statistically ($P < or = 0.05$) the same. Relative L from the time maximum occurred to harvest was linearly related to the relative cumulative evapotranspiration that occurred from maximum L to harvest time. The linear functions presented in this paper were used to model L in an irrigation scheduling model and thus in turn, model the evaporation process based on L. The irrigation scheduling model also modeled evaporation using crop coefficients. Modeling soil evaporation using modeled L improved the predictability of the model in the low moisture range for barley. The model was insensitive as to the method of modeling evaporation when predicting wheat yield and evapotranspiration. (Author's abstract)
W87-05521

PLANT WATER BALANCE,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
For primary bibliographic entry see Field 2I.
W87-05595

OVERVIEW ON THE PRESENT STATUS OF THE CONCEPTS OF WATER BALANCE MODELS,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 2A.
W87-05727

AVAILABILITY OF EVAPORATION DATA IN SPACE AND TIME FOR USE IN WATER BALANCE COMPUTATIONS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W87-05728

EFFECTS OF LAND USE ON THE HYDROLOGY OF SMALL BASINS IN HESSEN (FEDERAL REPUBLIC OF GERMANY),
Giessen Univ. (Germany, F.R.). Inst. fuer Mikrobiologie und Landeskultur.
For primary bibliographic entry see Field 2A.
W87-05738

PLANT WATER RELATIONS IN LYCHEE: EFFECTS OF SOLAR RADIATION INTERCEPTION ON LEAF CONDUCTANCE AND LEAF WATER POTENTIAL,
Queensland Dept. of Primary Industries, Nambour (Australia). Maroochy Horticultural Research Station.
For primary bibliographic entry see Field 2I.
W87-05867

PLANT WATER RELATIONS IN LYCHEE: DIURNAL VARIATIONS IN LEAF CONDUCTANCE AND LEAF WATER POTENTIAL,
Queensland Dept. of Primary Industries, Nambour (Australia). Maroochy Horticultural Research Station.
For primary bibliographic entry see Field 2I.
W87-05868

EFFECTS OF POPULATION DENSITY AND INTERCROPPING WITH COWPEA ON THE WATER USE AND GROWTH OF SORGHUM IN SEMI-ARID CONDITIONS IN BOTSWANA,
Agricultural Research Station, Gaborone (Botswana). Dryland Farming Research Scheme.
For primary bibliographic entry see Field 2I.
W87-05869

EFFECT OF SOIL TEMPERATURE ON EVAPOTRANSPIRATION BY C3 AND C4 GRASSES,
Agricultural Research Service, Beckley, WV. Appalachian Soil and Water Conservation Research Lab.
C. M. Feldhake, and D. G. Boyer.
Agricultural and Forest Meteorology, Vol. 37, No. 4, p 309-318, September 1986. 3 fig, 4 tab, 15 ref.

Descriptors: *Evapotranspiration, *Soil temperature, *Grasses, Leaves, Soil heat flux, Canopy, Roots.

Many studies have shown a relationship between water uptake, growth, and soil temperature. The relationship between evapotranspiration (ET) and soil temperature was studied for two C3 and two C4 grasses grown in 20-cm plastic containers and managed to provide 10-cm high dense leaf canopies. Soil temperature treatments were 13, 21, and 29 C while leaf canopies were exposed to ambient climate conditions. Except for one C3 grass at the highest soil temperature, all grasses had higher ET as soil temperature increased. The C4 grasses averaged 30% lower ET than the C3 grasses at 13 C soil temperature, but the relative difference decreased to only 10% lower than the non-stressed C3 grass at 29 C soil temperature. Canopy temperature showed no statistical relation to soil temperature. Soil heat flux differences appeared to have a greater influence on ET than plant resistance changes due to the influence of soil temperature on roots. (Authors' abstract)
W87-05870

EVAPOTRANSPIRATION AND GROUNDWATER RECHARGE - A CASE STUDY FOR DIFFERENT CLIMATE, CROP PATTERNS, SOIL PORPERTIES AND GROUNDWATER DEPTH CONDITIONS,
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Oekologie.
M. Renger, O. Strebel, G. Wessolek, and W. H. M. Duynisveld.
Zeitschrift fuer Pflanzenernahrung und Bodenkunde ZPBOAL, Vol. 149, No. 4, p 371-381, August 1986. 9 fig, 1 tab, 9 ref.

Descriptors: *Model studies, *Evapotranspiration, *Groundwater recharge, Soil physical properties, *Groundwater depth, *Hannover, *Soil-water-plant relationships, WestGermany, Land use, Agriculture, Climatic data, Soil water suction.

Actual evapotranspiration and net groundwater recharge (drainage minus capillary rise) as a function of climate, soil properties, land use and groundwater depth were determined for a 15-year period in the region north of Hannover, WestGermany. Calculations were done using a simulation model calibrated for cropland, grassland and coniferous forest. The two layer simulation model required the following input parameters: climate data, physical soil properties, crop data, and groundwater depth. Results of a sensitivity study showed, that the influence of climatic factors on actual evapotranspiration and net groundwater recharge increased with the amount of plant available water during the vegetation period. Under similar climatic conditions, evapotranspiration and groundwater recharge mainly depended on the two basic soil-physical relations between soil water content and suction and soil hydraulic conductivity and suction. For same groundwater depths, evapotranspiration rose with increasing plant available water in

the rootzone, whereas groundwater recharge decreased. (Main-PTT)
W87-05887

2E. Streamflow and Runoff

FUTURE OF TURFGRASS MANAGEMENT AND UNDERGROUND WATER QUALITY,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W87-05271

INITIATION AND FLOW BEHAVIOR OF THE 1980 PINE CREEK AND MUDDY RIVER LAHARS, MOUNT ST. HELENS, WASHINGTON,
Cascades Volcano Observatory, Vancouver, WA.
For primary bibliographic entry see Field 2J.
W87-05307

IT NEVER RAINS BUT IT DRIZZLES,
Flinders Univ. of South Australia, Bedford Park.
For primary bibliographic entry see Field 2B.
W87-05353

ASSEMBLAGE ORGANIZATION OF STREAM FISHES: THE EFFECT OF RIVERS ON ADVENTITIOUS STREAMS,
Northern Illinois Univ., De Kalb. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-05354

FORAGING RESPONSES OF STILTS (HIMANTOPUS SPP.: AVES) TO CHANGES IN BEHAVIOUR AND ABUNDANCE OF THEIR RIVERBED PREY,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-05512

PREY SELECTION BY TORRENTFISH, CHEIMARRICHTHYS FOSTERI HAAST, IN THE ASHLEY RIVER, NORTH CANTERBURY, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-05513

EFFECTS OF FLOODS ON THE INVERTEBRATE FAUNA OF A LARGE, UNSTABLE BRAIDED RIVER,
Ministry of Agriculture and Fisheries, Wellington (New Zealand). Fisheries Research Div.
P. M. Sagar.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 37-46, 1986. 5 fig, 2 tab, 37 ref.

Descriptors: *Floods, *Braided rivers, *Species diversity, *Species composition, *River flow, *Seasonal variation, *Lower Rakaia River, Larvae, Standing crops, Predation, Benthos, Invertebrates.

The abundance and species composition of benthic invertebrates were studied at three sites in the Lower Rakaia River for one year, and continued at one of these sites for a further year. A total of 33 taxa were identified. Trichoptera (15 species) and Diptera (7 species) were the most common species. Larvae of mayfly Deleatidium were, however, numerically dominant, comprising up to 96% of samples. Species abundance and diversity were low, probably because of the frequent floods. Abundance was inversely related to antecedent discharge and was least following severe floods of about 550 cu m/s. Species diversity and standing crop were greater during the more stable winter flows than during the flood-prone spring, summer, and autumn flows. The similarity of species composition decreased with increasing distance between sites but was least between years at one site, probably as a result of changed frequency of floods. Increases in species abundance and diversity were recorded even during short periods of relatively low stable flows. Floods which cause a significant increase in bed load movement are, however, likely to affect specific browsers and sedentary species more than collector-browsers, filter feeders, predators, and free-living species. It is concluded that low species diversity is likely to characterize unstable, braided rivers. (Author's abstract)
W87-05514

PHYSICALLY-BASED FOREST HYDROLOGY MODEL II: EVALUATION UNDER NATURAL CONDITIONS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
D. L. Thomas, and D. B. Beasley.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 973-981, July-August 1986. 19 fig, 3 tab, 17 ref. USDA-FS Grants 19-81-54 and 19-82-063.

Descriptors: *Rainfall-runoff relationship, *Forest hydrology, *Model studies, *Mathematical models, *Performance evaluation, *Forest watersheds, *Runoff forecasting, *Flood peak, Simulation, ANSWERS, Statistical analysis, Runoff, Base flow, Watersheds.

A newly developed, forest hydrology model was evaluated under natural forest conditions. This distributed, event-oriented, watershed scale model was developed and tested on seven individual watersheds in the Southeastern U. S. (five in Mississippi and two in North Carolina). The model produced reasonable results from the upland watersheds in central Mississippi. The upland area as well as other physiographically similar regions in the upper Coastal Plain are a large area for immediate model application. Due to the distributed nature of the model, combined agricultural and forested watersheds can be potentially simulated. The model underestimated the recession limb flow from watersheds in the Appalachian mountain region which tend to have large baseflow components. Additional changes to the model will be necessary before it may be successfully applied under mountainous conditions. A statistical analysis of the peak flow rate and total runoff estimates showed a highly significant relationship between measured and simulated values for the majority of the watersheds simulated. The total runoff estimates for several watersheds were significantly lower than the measured values. However, these runoff results may be improved with more representative parameter estimates. (See also W87-05522) (Author's abstract)
W87-05523

BEHAVIOR OF 226RA IN THE MISSISSIPPI RIVER MIXING ZONE,
Texas A and M Univ., College Station. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W87-05557

OPERATIONAL FLOOD WARNING SYSTEM,
For primary bibliographic entry see Field 4A.
W87-05562

EPISODES OF VERTICAL ACCRETION AND CATASTROPHIC STRIPPING: A MODEL OF DISEQUILIBRIUM FLOOD-PLAIN DEVELOPMENT,
Wollongong Univ. (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W87-05601

PLAN FOR RESEARCH ON FLOODS AND THEIR MITIGATION IN THE UNITED STATES,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 4A.
W87-05716

METEOROLOGICAL RESEARCH NEEDS ON FLOODS AND THEIR MITIGATION,
Maryland Univ., College Park. Inst. for Physical Science and Technology.
For primary bibliographic entry see Field 7A.
W87-05717

RESEARCH PROBLEMS IN HYDROLOGY AND HYDRAULICS,
R. K. Linsley.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 41-51, 2 ref.

Descriptors: *Peak flow, *Floods, *Storm surges, *Flood forecasting, *Tsunamis, *Flood hydrographs, Flood control, Flood plain management, Flood plain zoning, Floodproofing, Flood protection, Tidal waves, Tidal floods, Research priorities, Flood insurance, Ice jams, Landslides, Flash floods, Flood-control storage.

Since all flood mitigation efforts are founded on a concept of risk, research is needed in hydrology and hydraulics to identify flood flows and stages in order to assess the risk of flooding. A systematic test of procedures is recommended for estimating flood probability at ungaged locations. The effect of changes in land use or land management practices on flood peaks, flood volume, and sediment production should be considered, and techniques for estimating flood flows in natural channels or predicting stages for given flow rates should be improved. Auxilliary research includes collecting data for storm surge models, investigating measures to protect against storm surges and tsunamis, studying the sources of large debris in streams in flood and their removal, investigating ice jam formation and its elimination, predicting the probability of occurrence of landslides, predicting the joint probaility of high tides and flood peaks in coastal streams, and studying the hydraulics of flow on alluvial fans to determine ways in which the area of potential flooding can be defined and the probabilty of flooding can be quantified. (See also W87-05716) (Geiger-PTT)
W87-05718

ECOLOGICAL PERSPECTIVE ON FLOOD MITIGATION,
Kansas State Univ., Manhattan. Div. of Biology.
G. R. Marzolf.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 55-68, 1 fig, 22 ref.

Descriptors: *Flood damage, *Flood plains, *Flood plain management, *Environmental policy, *Ecological effects, Flood hydrographs, Research priorities, Flood control, Flood protection, Ecosystems, Land use, Wildlife habitats, Wetlands, Watersheds, Management planning, Soil erosion.

The ecological perspective of floods considers the role of flooding in natural stream and river ecosystems. Beneficial river functions may take the form of maintaining water quality, decomposing organic matter and producing fish and wildlife. The influence of flood mitigation strategies that modify channels or inappropriate land uses may have more detrimental effects on these benefits than the flooding itself. Flood mitigation planning activities should be approached on an entire watershed basis. There is a need to develop public understanding of the river and its flood plain as a single natural unit, and to evaluate flood mitigation proposals in terms of natural benefits in the streams and rivers themselves, in the flood plains, and in the wetlands. Models should be developed that will help evaluate natural benefits of floods. The organic matter decomposition processes and their relation to water quality should be examined. The effects of flood mitigation activity (dams, levees and bank stabilization) should be studied, especially in relation to downstream discharge regimes. Land uses and management practices over entire drainages should be related to the hydrological and erosional contributions of storm flows. Flood plains should

be classified in relation to their dependence on and tolerance of flooding. Since there is a growing literature on the effects of flooding on riparian vegetation, the initial phases of this area of research may be examined in a straightforward literature review. (See also W87-05716) (Geiger-PTT)
W87-05719

PUBLIC HEALTH RESEARCH NEEDS,
Epidemiology Research Center, Tampa, FL.
F. M. Wellings.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 71-80, 11 ref.

Descriptors: *Public health, *Epidemiology, *Flood plain management, *Flood damage, *Data collections, Mortality, Morbidity, Sanitation, Flood forecasting, Flooding, Communication, Flood protection, Research priorities, Safety, Management planning, Flood control, Land use.

Public health is impacted by all facets of flood hazard mitigation. Research which would result in improved forecasting, more timely evacuation warnings, sustained communication channels, and flood data collection networks would be of distinct value to public health aspects of flood hazard mitigation. Many of these needs must be met through a multidisciplinary approach. Research priorities to safeguard public health in the event of flooding include the development of a systematic data base for the various types of floods showing morbidity and mortality, execution of appropriate epidemiological studies, determination of the appropriate land use and management measures to reduce pollution and flood hazards in general, evaluation of present methods of maintaining wastewater treatment services during and after floods, determination of the effect of evacuation procedures on morbidity and mortality both on the short- and long-term basis, evaluation of all available flood hazard mitigation plans to determine the best plan for each type of flood, evaluation of the success or failure of the various mitigation plan components following different types of flood events, and determination of the effect of flooding on the quality of groundwater and surface water used as potable sources. (See also W87-05716) (Geiger-PTT)
W87-05720

AGENDA FOR ECONOMIC RESEARCH ON FLOOD HAZARD MITIGATION,
Florida Univ., Gainesville. Dept. of Economics.
J. W. Milliman.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 83-104, 1 fig, 30 ref.

Descriptors: *Flood damage, *Economic aspects, *Cost analysis, *Flood control, *Flood insurance, Flood plain management, Flood protection, Public policy, Flood plain zoning, Economic evaluation, Economic justification, Research priorities, Project planning.

An agenda is set forth for needed economic research in the field of flood hazard mitigation as part of a multidisciplinary effort to develop a comprehensive plan of research as commissioned by the National Science Foundation. Six categories of research are identified: changing the emphasis of policy from hazard reduction to a goal of efficient use of flood plain lands, defining the public role in mitigation policy, specifying the efficient level of mitigation, identifying deficiencies of current measures of losses and developing proper measures of economic losses, evaluating existing mitigation policies in light of policy changes in the past decade, and studying cost-benefit analyses of selected nonstructural measures. Research priorities identified in the agenda for economic research and policy analysis include: working with all groups to achieve agreement on redefinition of the objective of flood hazard mitigation, defining the economic rationale for public action within the context of individual choice, obtaining a consensus among economists on proper measures of flood losses and benefits of hazard mitigation policies, specifying the kind of economic data to be collected to conduct economic analysis, and evaluating the economic aspects of existing public policies and institutions for flood hazard mitigation, especially the National Flood Insurance Program, flood plain management, flood forecasting and flood warning systems, emergency relief and recovery assistance programs, and alternative policies for financing and cost-recovery for flood hazard mitigation policies. (See also W87-05716) (Geiger-PTT)
W87-05721

INTERDISCIPLINARY RESEARCH,
Colorado Univ. at Boulder. Inst. of Behavioral Science.
G. F. White.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 173-180, 2 ref.

Descriptors: *Research priorities, *Interdisciplinary studies, *Data collections, *Flood control, *Barrier islands, Flood plain management, Flood damage, Flood plain zoning, Flood protection, Flood forecasting, Management planning, Data interpretation, Coastal zone management.

Wise flood plain management decisions generally need to use findings from several disciplines, while the basic research work is done within disciplines for the most part. To improve the quality of flood plain management through research, three different though complementary lines can be followed. Wherever practicable the traditional disciplinary research can be encouraged to incorporate relevant methods and data from other fields. Measures to speed up and strengthen the interpretation of research findings to users can be facilitated. Interdisciplinary research can be initiated where the need for answers is especially urgent and where there is prospect for a successful inquiry leading to direct application. The principal directions of flood plain research which might benefit from taking account of possible contributions from other disciplines are discussed. Three research programs of high priority that should be undertaken from the outset as interdisciplinary ventures are: the evaluation of major policies and programs, the design for a basic data system, and studies of flooding on the barrier islands of the Atlantic Coast and Gulf of Mexico. As background for these recommended research programs, the principal modes of interdisciplinary activities in the province of floods are reviewed. The least complicated and most common mode involves one investigator drawing upon the knowledge of another discipline. A second and more complicated mode involves tracing and evaluating the effects of a technical or policy intervention. A third mode involves certain methods of eliciting and presenting information. Interdisciplinary collaboration is essential to the design of the improved data systems that are recommended for collection and storage of flood plain information. (See W87-05716) (Geiger-PTT)
W87-05725

NEW APPROACHES IN WATER BALANCE COMPUTATIONS,
International Association of Hydrological Sciences.
For primary bibliographic entry see Field 7B.
W87-05726

APPLICATION OF ENVIRONMENTAL ISOTOPE TECHNIQUES IN WATER BALANCE STUDIES OF SMALL BASINS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
For primary bibliographic entry see Field 2A.
W87-05734

WATER BALANCE APPROACH TO THE STUDY OF ARIDITY AND DROUGHTS WITH SPECIAL REFERENCE TO INDIA,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
For primary bibliographic entry see Field 2A.
W87-05736

SYNOPTIC WATER BALANCE MAPPING IN SWEDEN,
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
For primary bibliographic entry see Field 2A.
W87-05737

INNOVATIVE TECHNIQUES FOR COLLECTING HYDROLOGIC DATA,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
A. J. Bowie, and O. W. Sansom.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-59 to 1-69, 4 fig, 2 tab, 3 ref.

Descriptors: *Data collection, *Hydrologic data, *Goodwin Creek, *Mississippi, *Sediment transport, *Streams, Watershed, Channel stability, Cost analysis, Electronic equipment.

The USDA Sedimentation Laboratory has established a comprehensive data collection facility on the Goodwin Creek research watershed in northern Mississippi, for the study of agricultural hydrology and stream channel stability. This 21.4 sq km watershed has been intensively instrumented to study the movement of water sediment from agricultural lands and the problems of instability in stream channels. Most of the field data acquisition takes place at fourteen supercritical-flow flumes strategically located on Goodwin Creek and its major tributaries. Advanced technology is being used for acquisition of much of the hydrologic data. A major part of the system involves the use of VHF-radio for data transmission. Description of the instrumentation and experiences with the data acquisition system are presented. The cost effectiveness of this system depends on several factors, (1) the quality of data, (2) the need for time synchronization of data from different locations, (3) the importance of minimizing delay in having data available for processing, and, (4) the importance of making real time responses to the measurements made by the system. An important element of the system has been the inclusion of backup recorders for streamflow stage and precipitation data. The presence of charts has not only helped build confidence in an unfamiliar system, but has helped prevent data loss during possible catastrophic events such as station failure due to lightning. (See also W87-05740) (Lantz-PTT)
W87-05747

UNDER WATER MAPPING RIVER CHANNELS AND RESERVOIRS,
Water and Power Resources Service, Denver, CO.
For primary bibliographic entry see Field 7B.
W87-05749

DRAINAGE DENSITY VERSUS RUNOFF AND SEDIMENT YIELD,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
P. B. Allen.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-38 to 3-44, 3 fig, 2 tab, 5 ref.

Descriptors: *Drainage density, *Soil erosion, *Runoff, *Sediment yield, *Southern plains, Mathematical studies, Remote sensing, Aerial photography, Data interpretation, Watersheds, Channels.

Runoff and sediment yields were correlated to watershed drainage densities derived by various procedures for 17 watersheds in the U.S. Southern Plains. The best correlations, r squared=0.88 for runoff and r squared=0.83 for sediment yield, resulted with drainage densities determined with a remote sensing technique using aerial photography. The procedure used to determine drainage density is described in detail because drainage den-

sity is affected by the scale of the base map or aerial photo, the magnification of the viewing instrument, and the definition for an initial channel. These relationships, proven only for U.S. Southern Plains watersheds, will be useful for prediction purposes if similar correlations are found for other areas. (See also W87-05740) (Author's abstract)
W87-05760

SEDIMENT YIELD AND RUNOFF AFTER TIMBER HARVEST,
Bureau of Land Management, Missoula, MT.
For primary bibliographic entry see Field 2J.
W87-05763

RIVER SEDIMENT BUDGET,
Army Engineer District, Sacramento, CA.
For primary bibliographic entry see Field 2J.
W87-05764

APPLICATION OF STREAMTUBE COMPUTER MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
A. Molinas, C. W. Denzel, and C. T. Yang.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 6-55 to 6-64, 6 fig, 6 ref.

Descriptors: *Computer models, *Streamtube models, *Mississippi River, *Stream flow, *Sediment transport, *Illinois, *Missouri, Model studies, Sediment distribution, Hydraulic properties, Mathematical studies, Simulation analysis.

A computer model based on the stream tube concept was used to study the erosion patterns at Stage I cofferdam site of Lock and Dam No. 26 (Replacement) project for the period of January-April 1982. The five mile modeling reach is located between the existing Lock and Dam No. 26, near St. Louis, Missouri, and Hartford, Illinois, on the Mississippi River. The computer model was originally developed for the U.S. Bureau of Reclamation to route water and sediment in alluvial channels. The concept of stream tubes is designed to allow the lateral and longitudinal variation of hydraulic conditions as well as sediment activity at cross sections along a study reach. The computer program is a semi-two-dimensional program with the third dimension, depth, being intrinsically incorporated into the computations. Daily stage-discharge values at the gaging station, located at the downstream end of the study reach, were used for the hydraulic computations. Sediment routing computations were performed starting with the existing sediment size distribution. Simulation results at the cofferdam site, presented in the form of topographic maps of the channel bed, indicate close agreement to actual measured data. (See also W87-05791) (Author's abstract)
W87-05813

SEDIMENT TRANSPORT AND RIVER SIMULATION MODEL,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 2J.
W87-05814

RUNOFF-SEDIMENT YIELD MODEL FOR SEMIARID REGIONS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
For primary bibliographic entry see Field 2J.
W87-05815

ALLUVIAL COMPUTATIONS IN COMPLEX RIVER NETWORKS,
Iowa Inst. of Hydraulic Research, Iowa City.
For primary bibliographic entry see Field 2J.
W87-05820

OFFSITE SEDIMENT IMPACTS USING BASIN SCALE SIMULATION,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2J.
W87-05821

BUDGET ANALYSIS OF TURBIDITY AND STREAMFLOW DATA,
Umpqua National Forest, Roseburg, OR.
For primary bibliographic entry see Field 6G.
W87-05833

NUTRIENT-SEDIMENT RELATIONS IN STREAMFLOW,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W87-05840

DERIVATION OF A NEW VARIABLE INSTANTANEOUS UNIT HYDROGRAPH,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
S. J. Chen, and V. P. Singh.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 25-42, November 1986. 3 fig, 12 tab, 12 ref. NSF Project NSF-INT-8400205.

Descriptors: *Unit hydrographs, *Rainfall-runoff relationships, *Instantaneous unit hydrographs, *Flow forecasting, *Mathematical models, *Mathematical studies, *China, Watersheds, Rainfall, Runoff, Model studies.

A new variable instantaneous unit hydrograph (NVIUH) was derived by employing a second order representation of the convolution integral and a nonlinear storage-discharge relation. This derivation removed a conceptual inconsistency from Ding's variable instantaneous unit hydrograph (DVIUH), and led to an analytical expression for the second order kernel. An alternative procedure for the derivation of DVIUH was also formulated. The NVIUH was verified on two watersheds in China, and was found to be superior to both Nash's instantaneous unit hydrograph and DVIUH. (Author's abstract)
W87-05844

RIVER MEANDERS AND CHANNEL SIZE,
Geological Survey, Lakewood, CO. Water Resources Div.
G. P. Williams.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 147-164, November 1986. 4 fig, 2 tab, 40 ref.

Descriptors: *Data collections, *Model studies, *Channel morphology, *Geomorphology, *Meanders, *Rivers, *Channels, *Mathematical equations.

An enlarged data set was used to (1) compare measured geometry to that predicted by Langbein and Leopold theory, (2) examine the frequency distribution of the ratio of curvature to channel width, and (3) derive 40 empirical equations (31 of which are orginal) involving meander and channel size features. The data set, part of which came from publications by other authors, consists of 194 sites from a large variety of physiographic environments in various countries. The Langbein-Leopold theory agreed well with the field data (78 sites). The ratio of radius of curvature to channel width has a modal value in the range of 2 to 3, in accordance with earlier work; about one third of the the 79 values is less than 2.0. The 40 empirical equations, most of which only include two parameters, involve the channel cross section dimensions (bankfull area, width, and mean depth and meander features (wavelength, bendlength, radius of curvature, and belt width). These relations have very high correlation coefficients, mostly between 0.95 and 0.99. Although channel width traditionally had served as a scale indicator, it was shown that bankfull cross sectional area and mean depth could also be used for this purpose. (Author's abstract)
W87-05851

NONLINEAR FLOOD FORECASTING BY THE FILTER SEPARATION AR METHOD,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
M. Hino, and C. H. Kim.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 165-184, November 1986. 9 fig, 20 ref.

Descriptors: *Flood forecasting, *Mathematical methods, *Statistical methods, *Rainfall-runoff relationships, *Statistical analysis, Flood hydrographs, Unit hydrographs, Time series, Runoff, Rainfall, Predicition, Computers, Floods.

The flood prediction problem is especially difficult because of the nonlinearity of a hydrologic system and the stochasticity of rainfall-runoff phenomena. The filter separation AR method was applied in this paper. At each time step, the runoff time series data sampled at equal intervals were separated through a numerical filter, into both shorter and longer period components. Each subsystem is linear and expressible by the ARX method (autoregressive with exogeneous input) or by its conversion form of convolution integral. The effective rainfall components for each subsystem were inversely estimated sequentially from the seperated time series of a runoff component, either directly from the ARX expression or by solving the simultaneous equations of the convolution integral type, by the linear programming method under the restriction of positive effective rainfalls and minimal errors. Future runoff was predicted with the input of future rainfall for the subsystems either by extrapolating the inversely estimated effective rainfall or by utilizing the given observed rainfall data. The online flood predicted by the presented method was performed easily and quickly by a small personal desk top computer. (Author's abstract)
W87-05852

FOSSIL SOILS AS GROUNDS FOR INTERPRETING LONG-TERM CONTROLS ON ANCIENT RIVERS,
Oregon Univ., Eugene. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W87-05858

ALGORITHM FOR ROUTING UNSTEADY FLOWS IN URBAN DRAINAGE NETWORKS,
Gutteridge, Haskins and Davey Pty Ltd., Sydney (Australia).
J. E. Ball.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p. 327-341, 1985. 9 fig, 1 tab, 16 ref.

Descriptors: *Unsteady flow, *Urban hydrology, *Drainage patterns, *Nonuniform flow, *Algorithms, *Urban areas, Hydrographs, Saint Venant equations, Amein scheme, Manhole surcharge, Flow, Drainage engineering, Networks.

Flow in an urban drainage network is usually unsteady and the routing of hydrographs through a network is an important aspect of the design and analysis of urban drainage networks. The use of numerical solution of the Saint Venant equations to determine the propagation of unsteady flows through pipes has been validated many times. Amongst the many numerical techniques which have been developed for the analysis of unsteady flows in open channels is the four-point implicit finite difference scheme, commonly referred to as the Amein scheme. Use of the Amein requires the solution of C x dclta nu = -R, where C is a large sparse n x n matrix, and delta nu and R are n x 1 column vectors. The proposed algorithm uses the properties of the drainage network to develop an efficient algorithm for the solution of this equation. This algorithm is based upon partitioning and decomposing the coefficient matrix C. As an additional advantage, the proposed solution algorithm enables the determination of the water surface level within a manhole and, hence, the possibility of surcharge at a manhole. (Author's abstract)
W87-05860

EFFECTS OF FOREST CLEARCUTTING IN NEW ENGLAND ON STREAM MACROINVERTEBRATES AND PERIPHYTON,

Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 4C.
W87-05875

DISSOLVED ORGANIC CARBON DYNAMICS IN TWO SUBTROPICAL BLACKWATER RIVERS,
Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-05898

POLAROGRAPHIC STUDY OF THE INTERACTION BETWEEN HUMIC ACIDS AND OTHER SURFACE-ACTIVE ORGANICS IN RIVER WATERS,
Otago Univ., Dunedin (New Zealand). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W87-05905

2F. Groundwater

DETECTION OF SUBSURFACE SALINITY WITHIN THE NORTHERN SLOPES REGION OF VICTORIA, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 5B.
W87-05213

TRIANGLE CONSERVATION DISTRICT - A CASE STUDY IN DRYLAND SALINE SEEP CONTROL,
Triangle Conservation District, Conrad, MT.
For primary bibliographic entry see Field 5G.
W87-05217

GROUNDWATER--THE CHANGING PROBLEM IN TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 4B.
W87-05220

OGALLALA AQUIFER - FACTS AND FALLACIES,
Texas Dept. of Water Resources, Austin.
T. Knowles.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 23-31, 3 ref.

Descriptors: *Aquifers, *Aquifer characteristics, *Aquifer management, *Ogallala Aquifer, *Texas, Groundwater management, High Plains Aquifer, Simulation analysis, Model studies, Water level, Groundwater quality, Groundwater depletion, Water use.

The Ogallala is one of the most intensively developed aquifer in the country, and it underlies about 35,000 sq mi of Texas. One of the early false notions of the aquifer was the belief that water was pumped from an underground river. Another popular fallacy was that the aquifer received recharge from the Rocky Mountain streams. Associated with this was the idea that the supply of water available from the Ogallala was unlimited. An idea that apparently is held by many people who live east of the High Plains is that one day the wells suddenly stop pumping since the aquifer will be dry. Visions of overnight unemployment and financial ruin are seen. Although any specific well may suddenly stop producing water, the reason generally is not because the resource is depleted. Water levels could have dropped below the pump, the well could have collapsed, or the pump motor could have failed; and, although the aquifer is being depleted, but the results of this depletion generally appear slowly. The Ogallala Formation is the most productive formation on the Texas High Plains. Other formations on the High Plains yield water, and in some areas, there is little reason to differentiate between formations because of the good hydrdaulic communication between them. The basal Ogallala sediments are primarily sand and gravel with occasional thin clay layers. The thickness of the Ogallala Formation is primarily controlled by the topography of the eroded pre-Ogallala surface, occurs where sediments have filled previously eroded river channels, and ranges up to 900 ft thick. Most of this formation is saturated with water, with the USGS estimating that the High Plains Aquifer contained 3,230 million acre-ft of saturated material prior to the beginning of significant irrigation on the High Plains. Applying the commonly accepted porosity value of 40% results in an estimate that 1.1 billion acre-ft of water was in the ground although most of that volume is not recoverable. Using a specific yield value of 16% results in a total drainable water estimate of 517 million acre-ft. Model studies conducted by the State of Texas, have shown that the aquifer can continue to be a source of substantial amounts of groundwater for several decades. The northern area contains most of the water now and this would continue to be so. (See also W87-05219) (Lantz-PTT)
W87-05222

ENHANCED RECOVERY OF GROUNDWATER FROM THE UNSATURATED ZONE: THE OGALLALA CASE,
Texas Agricultural Experiment Station, College Station.
For primary bibliographic entry see Field 4B.
W87-05223

REGIONAL HYDROGEOLOGY OF THE EDWARDS AQUIFER, SOUTH CENTRAL TEXAS,
Texas Univ. at El Paso. Dept. of Geological Sciences.
W. W. Hammond.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 53-68, 3 fig, 19 ref.

Descriptors: *Geohydrology, *Edwards Aquifer, *Texas, *Aquifers, Water use, Carbonate rocks, Limestone, Lithology, Permeability, Groundwater movement, Porosity, Flow velocity, Pumping, Water demand, Groundwater potential.

The Edwards Aquifer, of South central Texas, provides water for the municipl, industrial, and agricultural needs of an 8,000 sq mi area with a population of over 1 million people. The Edwards Aquifer occurs in carbonate rocks of the Edwards Ground; the Georgetown Limestone; the Devils River Limestone, and the West Nueces, McKnight, and Salmon Peak Formations. Divided into an upper and lower unit, (Person Formation and Kainer Formation, respectively), there are eight hydrostratigraphic subdivisions to the Edwards Aquifer. Groundwater flow systems developed initially in syndepositional porosity and permeability. Secondary porosity and permeability occurred initially in areas of Cretaceous karstification. The direction of groundwater movement is controlled by faults where faulting has placed rocks of greatly different permeabilities in juxtaposition. Estimates of groundwater velocities indicate a range from 0.6 to 9.4 m/day. Residence time of groundwater in the confined freshwater zone is estimated to be approximately 35 years. The southern or downdip boundary of the aquifer is placed at the bad-water line, where concentrations of dissolved constituents in groundwater exceed 1,000 mg/L. Considerable uncertainty exists as to the response of the bad-water line to reserve pumpage stresses on the aquifer. The Regional Water Resource Study for the San Antonio region will determine water demands for the region, water sources including other aquifers, surface water, and recharge enhancement, and define a series of alternatives which will meet the needs of water suppliers and water users in the region to the yeara 2040. (See also W87-05219) (Lantz-PTT)
W87-05224

GULF COAST REGIONAL AQUIFER-SYSTEM AANLYSIS: AN OVERVIEW,
Geological Survey, Austin, TX.
H. F. Grubb.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 69-91, 10 fig, 2 tab, 24 ref.

Descriptors: *Aquifer systems, *Texas Coastal Uplands Aquifer System, *Mississippi Embayment Aquifer System, *Coastal Lowlands Aquifer System, *Aquifer characteristics, Geohydrology, Groundwater potential, Pumping, Texas, Water use, Groundwater movement.

The Gulf Coast Regional Aquifer-System Analysis is one of the studies being conducted in the U.S. Geological Survey's Regional Aquifer-System Analysis program. Regional aquifers in sediments of mostly Cenozoic age are being studied in an area of about 225,000 sq mi in the Coastal Plain of Alabama, Arkansas, Florida, Illinois, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, and Texas. Three aquifer systems have been identified: the Texas Coastal Uplands Aquifer System, the Mississippi Embayment Aquifer System in sediments of mostly Eocene age, and the Coastal Lowlands Aquifer System in sediments of Miocene and younger age. These aquifer systems thicken from less than a thousand feet thick near their updip limit, to many thousands of feet gulfward toward their downdip limits. Due to facies changes and shallow depths to the top of the geopressured zone, the thickest part of the Texas Coastal Uplands aquifer system, which exceeds 7,000 feet, is centered about 50 mi landward of the downdip limit of the system. The thickest part of the Mississippi Embayment Aquifer system is more than 5,000 feet, but less than 7,000 feet thick. The Coastal Lowlands Aquifer System is more than 10,000 ft thick in southern Texas and southern Louisiana. About 9,200 million gal/day in groundwater was pumped from the aquifers in the study area in 1980. About 19% of that pumpage was in Texas, mostly from the Coastal Lowlands Aquifer System. Harris County, Texas, is one of only four counties in the study area where groundwater pumped in 1980 exceeded 250 million gal/day. Regional groundwater flow in the three aquifer systems will be evaluated using both regional- and subregional-scale digital models. (See also W87-05219) (Author's abstract)
W87-05225

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT: A REPORT ON ITS CREATION, POWERS, LIMITATIONS OF POWERS, AND PROGRESS,
Butler and Binion, Houston, TX.
For primary bibliographic entry see Field 6E.
W87-05234

DEMOGRAPHIC AND SOCIAL DIMENSIONS OF GROUNDWATER USE AND MANAGEMENT,
Texas A and M Univ., College Station. Dept. of Rural Sociology.
For primary bibliographic entry see Field 6D.
W87-05237

ECONOMIC IMPLICATIONS OF CHANGING GROUNDWATER USE PATTERNS,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6C.
W87-05238

RESEARCH CONTRIBUTIONS TO WATER CONSERVATION TECHNOLOGIES,
Texas Agricultural Experiment Station, Lubbock.
For primary bibliographic entry see Field 3B.
W87-05239

LARGE-SCALE OPTIMIZATION MODELS FOR GROUNDWATER MANAGEMENT,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.

W87-05240

RENOVATING WASTEWATER WITH GROUNDWATER RECHARGE IN THE PHOENIX AREA,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 5D.
W87-05241

U.S. DEPARTMENT OF ENERGY HIGH-LEVEL NUCLEAR WASTE REPOSITORY PROGRAM: GROUNDWATER CONCERNS IN TEXAS,
Texas Governor's Nuclear Waste Program Office, Austin.
For primary bibliographic entry see Field 5E.
W87-05242

IMPACTS OF LIGNITE MINING ON GROUNDWATER IN TEXAS,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 4C.
W87-05243

GROUNDWATER IMPACTS OF SOLUTION MINING,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 4C.
W87-05244

POTENTIAL GROUNDWATER IMPLICATIONS OF LAND DISPOSAL OF TOXIC SUBSTANCES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5E.
W87-05245

GROUNDWATER MONITORING, CONTROL, AND ANALYSIS,
Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W87-05248

FUTURE OF TURFGRASS MANAGEMENT AND UNDERGROUND WATER QUALITY,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W87-05271

QUALITY OF BASEFLOWS AS AN INDEX OF AQUIFER YIELD IN THE BASEMENT COMPLEX AREA OF SOUTH-WESTERN NIGERIA,
Ife Univ. (Nigeria). Dept. of Geography.
O. O. Ogunkoya.
Journal of Environmental Management JEVMAW, Vol. 22, p 291-300, June 1986. 2 fig, 4 tab, 27 ref.

Descriptors: *Base flow, *Aquifer characteristics, *Tracers, *Water quality, *Nigeria, Hydrogen ion concentration, Dissolved solids, Ions, Tritium, River systems, Water quality, Rocks, Velocity, Flow characteristics, Conductivity, Chemical composition, Isotopes.

The chemical quality of base flows in terms of pH, total dissolved solids, conductivity, concentration of some constituent ions, tritium content and base flow discharges of seven third-order rivers draining the Basement Complex rocks of southwestern Nigeria was studied. Base flows were used to describe aquifer yield. The chemical quality of base flows of each river appears to be related to the chemical composition of the rocks they drain. Tritium unit values showed that some of the waters were of recent age, while some were much older (about 20 years). Total dissolved solids concentration was inversely related to base flow discharge. There was also an inverse relationship to tritium unit content which demonstrated that total dissolved solids concentration was a function of the residence time of water in the saprolite and rocks. Tritium unit content varied directly with base flow discharge suggesting a direct relationship between speed of water movement in the aquifer and aquifer yield. A knowledge of the chemical quality and isotope (3H) content of base flows from areas underlain by Basement Complex rocks in southwestern Nigeria may thus give an indication of the physical characteristics and yield of aquifers in this region. (Author's abstract)
W87-05272

USE OF THE HOOGHOUDT FORMULA FOR DRAIN SPACING CALCULATIONS IN HOMOGENEOUS-ANISOTROPIC SOILS,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W87-05433

CALCULATING THE QUALITY OF DRAINAGE WATER FROM NON-HOMOGENEOUS SOIL PROFILES WITH AN EXTENSION TO AN UNSATURATED-SATURATED GROUNDWATER QUALITY MODEL INCLUDING BYPASS FLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
H. C. Van Ommen.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 293-304, December 1985. 3 fig, 1 tab, 9 ref, 2 append.

Descriptors: *Path of pollutants, *Soil water, *Water quality, *Mathematical models, *Solutes, *Soil profiles, *Groundwater, *Drainage water, *Model studies, *Computer programs, Chemical composition, Computers, Mass balance equation, Mathematical equations, Mathematical studies, Adsorption, Decomposition, Transport, Breakthrough curves, Soil types, Accumulation, Zone.

A pseudo-analytical solution for the chemical concentration in drainage water from a soil profile is based on the mass balance equation. The effects of linear adsorption, decomposition and plant water uptake as well as the water content and layer thickness may be specified separately for each layer. The phenomenon of bypass flow can also be taken into account. From the obtained relationship between the concentration of solute in the drainage water leaving the soil profile and the time, a coupling between the unsaturated and the saturated zone can be achieved as was described earlier. This leads to breakthrough curves of the solute leaving the combined system of unsaturated and saturated zones. Time-dependent input concentrations can be easily be incorporated through the systems approach. Computer programs written for an HP41CV pocket calculator describe the quality of drainage water from non-homogeneous profiles and the breakthrough of a solute leaving the combined system. (Author's abstract)
W87-05434

INTERACTIVE COMPUTER GRAPHICS-BASED MULTIOBJECTIVE DECISION-MAKING FOR REGIONAL GROUNDWATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6A.
W87-05447

PROBLEMS IN MEASURING WATER SAMPLES OF DIFFERENT SALT CONTENT BY ICP-AES,
Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Anorganische Chemie und Kernchemie.
For primary bibliographic entry see Field 5A.
W87-05476

OPTIMIZING THE RAPID EVOLUTION OF TARGET GROUNDWATER POTENTIOMETRIC SURFACES,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
For primary bibliographic entry see Field 4B.
W87-05520

SIMULATED WATER TABLE MANAGEMENT BY CONTROLLED-DRAINAGE BASED ON RAINFALL FORECASTS,
Agricultural Research Service, Baton Rouge, LA. Soil and Water Pollution Research Unit.
J. L. Fouss, C. E. Carter, and J. S. Rogers.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 988-994, July-August 1986. 7 fig, 3 tab, 13 ref.

Descriptors: *Model studies, *Groundwater management, *DRAINMOD, *INDEX, *Water management, *Weather data collections, *Rainfall, Water table, Crop yield, Root zone, Prediction, Computers, Simulation, Soil profiles, Drainage.

A simulation study using DRAINMOD was conducted for southern humid climate and soil conditions to evaluate growing season water table management by controlled-drainage. Control was simulated by regulating the depth of an overflow weir at the drainage outlet. A rainfall probability INDEX, computed from daily records of National Weather Service forecasts, was used to simulate an override of the weir depth control, permitting free drainage in advance of predicted rainfall events. Controlled-drainage improved root zone soil-water management. In two of the six years, subirrigation (if available) would have increased relative corn yields by 25 and 82% over that achieved by controlled-drainage only. (Author's abstract)
W87-05525

PREDICTING SEASONAL IRRIGATION WATER REQUIREMENTS ON COARSE-TEXTURED SOILS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
J. L. Chesness, D. L. Cochran, and J. E. Hook.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1054-1057, July-August 1986. 2 fig, 5 tab, 15 ref.

Descriptors: *Irrigation requirements, *Model studies, *Soil texture, *Soil water, *Simulation, *Hydrologic budget, Root growth, Evaporation, Runoff, Rainfall, Percolation, Infiltration, Corn, Soybeans, Plant growth, Water use, Water requirement.

A water-balance model was developed for predicting seasonal irrigation water requirements. The model treats the soil as a multi-layered water storage reservoir. Reservoir capacity is defined by soil water desorption data, rate of root growth, and effective rooting depth. Water withdrawal rate or crop water use is determined from pan evaporation data corrected to potential ET and converted by consideration of plant growth stage. Rainfall is partitioned into runoff, effective precipitation, and deep percolation. Field data from corn and soybeans during the seasons 1979-81 on two soil types were used for verification. The mean absolute difference between predicted and measured seasonal irrigation water requirements was 16%. Simulation data were fitted to frequency distributions, and irrigation requirements are expressed in terms of probabilities. (Author's abstract)
W87-05535

MICROBIAL METABOLISM OF CHLOROPHENOLIC COMPOUNDS IN GROUND WATER AQUIFERS,
Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.
For primary bibliographic entry see Field 5B.
W87-05633

METABOLIC DIVERSITY AND ACTIVITY OF HETEROTROPHIC BACTERIA IN GROUND WATER,
Dayton Univ., OH. Dept. of Biology.
R. M. Ventullo, and R. J. Larson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 759-771, 1985. 3 fig, 6 tab, 51 ref.

Descriptors: *Pollutant identification, *Groundwater, *Species diversity, *Bacteria, *Metabolism, *Biodegradation, Accumulation, Mineralization, Isotope studies, Model studies, Kinetics, Heterotrophic activity.

The number and metabolic diversity of bacteria were studied in groundwaters collected in the United States and Canada. Bacterial numbers were determined by acridine orange direct counts, viable plate counts and 14C most-probable-number counts. Metabolic diversity was determined by heterotrophic activity and biodegradation potential assays using several classes of natural and xenobiotic substrates. Rates of metabolism in diversity studies (uptake and/or mineralization to carbon dioxide) were measured by radiotracer techniques and rate data were analyzed by nonlinear regression models to generate appropriate kinetic constants. Overall, the density and activity of groundwater bacteria were comparable to values reported for oligotrophic marine and freshwater systems. Bacterial numbers ranged from approximately 100 to 1000000 cells/ml, depending on the enumeration technique used and the particular sample tested. Turnover times for natural compounds in heterotrophic activity assays (i.e., glucose, amino acids) ranged from less than 100 to more than 2,000 h. Degradation half-lives for xenobiotic and natural substrates in biodegradation potential studies exhibited a comparable range of values. In general, our results indicate that groundwater bacteria have the potential to metabolize several classes of natural and xenobiotic substrates, although at reduced rates compared with those of surface water systems. (Author's abstract)
W87-05634

PROCEEDINGS OF THE ISSS SYMPOSIUM ON WATER AND SOLUTE MOVEMENT IN HEAVY CLAY SOILS.
International Society of Soil Science, Wageningen (Netherlands).
International Institute for Land Reclamation and Improvement, P.O. Box 45, 6700 AA Wageningen, The Netherlands, 1984. ILRI Publication 37. Edited by J. Bouma and P.A.C. Raats. 363 p.

Descriptors: *Groundwater movement, *Clays, *Symposium, *Solute transport, Clay minerals, Soil moisture retention, Simulation analysis, Measuring instruments, Soil water.

This book consists of the keynote papers, the expanded abstracts, and the discussions during the International Symposium on Water and Solute Movement in Heavy Clay Soils, held August 27-31, 1984 in Wageningen, The Netherlands. Heavy clay soils occupy large areas of the world. Their complex and variable structure leads to intricate patterns of water and solute movement. The following themes were covered in the symposium: (1) Development of structural patterns in swelling and shrinking clays; (2) Transport phenomena: water movement; (3) Transport phenomena: solute transport; and (4) Measurement and simulation techniques. (See also W87-05666 thru W87-05714) (Lantz-PTT)
W87-05665

ESTIMATION, AUTOCORRELATION, AND GROUNDWATER DATA IN WATER BALANCE MODELS,
Vrije Univ., Brussels (Belgium).
For primary bibliographic entry see Field 2A.
W87-05729

PRIORITIZING SURFACE WATER QUALITY PROBLEMS,
Agricultural Research Service, Morris, MN.
For primary bibliographic entry see Field 5G.
W87-05822

POLYCHLORINATED BIPHENYLS IN THE HOUSATONIC RIVER,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-05829

DENITRIFICATION IN GROUNDWATERS, PRINCIPLES AND METHODS FOR ITS IDENTIFICATION: A REVIEW (LA DENITRIFICATION DANS LES EAUX SOUTERRAINES, PRINCIPES ET METHODES DE SON IDENTIFICATION: UNE REVUE),
Paris-6 Univ. (France). Lab. de Biogeochmie des Isotopes Stables.
For primary bibliographic entry see Field 5A.
W87-05843

USE OF MATRIX DIFFERENTIAL CALCULUS IN PROBLEMS OF MULTIPLE-AQUIFER FLOW,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
C. Maas.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 43-67, November 1986. 7 fig, 18 ref, 2 append.

Descriptors: *Mathematical studies, *Mathematical equations, *Multiple aquifer flow, *Groundwater movement, *Geohydrology, Aquifers.

The formulation of boundary value problems in the field of multiple-aquifer flow into the terms of matrix differential equations, and the subsequent solution of the boundary value problems in terms of matrix functions is demonstrated. The technique is applied to five examples of practical interest: (1) one dimensional steady multiple aquifer flow near a fully penetrating river; (2) one dimensional multiple aquifer flow near a partially penetrating river; (3) steady radial flow towards a well in a multiple aquifer system; (4) non-steady multiple aquifer flow towards a well in the center of a circular island; and (5) steady multiple aquifer flow towards a well in the presence of a rectilinear partially penetrating river. These examples showed the advantage of the technique which is the conciseness of both the derivation and the presentation of the outcome. Matrix differential calculus is appealing by its close resembelance to plain differential calculus and, in a way, offers the possibility to unify the treatment of single- and multiple-aquifer flow. Multiplicity of aquifers being the rule rather than the exception, the technique will prove to be a real benefit in solving many geohydrology problems. (Ram-PTT)
W87-05845

INFLUENCE OF DIFFUSE SOURCES OF CONTAMINATION ON THE QUALITY OF OUTFLOWING GROUNDWATER INCLUDING NON-EQUILIBRIUM ADSORPTION AND DECOMPOSITION,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 5B.
W87-05847

EVALUATION OF SOME FORMULAS FOR DRAINAGE IN ARTESIAN AREAS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
H. A. Wolters.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 117-128, November 1986. 6 fig, 1 tab, 9 ref.

Descriptors: *Artesian flow, *Confined aquifers, *Drainage, *Water table fluctuations, *Mathematical equations, *Mathematical studies, Subsurface drainage, Water level, Aquifers.

Five formulas for the calculation of the height of the groundwater table in artesian aquifers are discussed. These five were used for calculation of several types of profiles. These profiles types were divided into two categories: (1) the maximum water table height as a function of the drain distance and the thickness of the covering layer, and precipitation either equalled zero or 10 mm per day; and (2) the maximum water table height as a function of the drain distance L and the thickness D, using parameters commonly observed in Dutch Polders, again precipitation either equalled zero or 10 mm/day. The results are evaluated and compared. (Ram-PTT)
W87-05849

CARBON-14 AND STABLE ISOTOPE DATA FOR AN AREA IN THE MURRAY BASIN: ITS USE IN ESTIMATING RECHARGE,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 5B.
W87-05850

RESISTIVITY MEASUREMENTS FOR GROUNDWATER INVESTIGATION IN THE UMM AL-AISH AREA OF NORTHERN KUWAIT,
Kuwait Univ., Safat. Dept. of Geology.
F. Al-Ruwaih, and H. O. Ali.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 185-198, November 1986. 11 fig, 1 tab, 9 ref. University of Kuwait Grant SG015.

Descriptors: *Exploration, *Aquifers, *Geophysics, *Electrical studies, *Groundwater potential, *Groundwater availability, *Resistivity, *Kuwait, Evalation, Groundwater, Salinity, Geohydrology.

Vertical electrical sounding measurements (VES), utilizing the Schlumberger array were conducted in the Umm Al-Aish area of Kuwait with a view to testing the possibilities and limitations of geoelectrical methods in exploration and evaluation of groundwater resources in that country. Here, localized freshwater zones occur in the upper portions of the Pleistocene sand and gravel aquifers. Iterative automatic inversion of VES data, coupled with bore hole information, resolved with some confidence the dry to saturated and fresh to saline water interfaces and revealed some correspondence between lithostratigrapical units and resistivity values. Maps of resistivity and transverse resistance values agree reasonably well with the general hydrogeological condition in this area. The results confirm the hypothesis that potable groundwater is associated with low relief, mainly along the central axial trend of the basin, where seasonal recharge is likely. Correlations were established between aquifer resistivity and water salinity and to a lesser extent between aquifer transverse resistance and potential area(s) for fresh groundwater production. These correlations could be used to assist in exploration and evaluation and of groundwater resources in new target areas in Kuwait where lithostratigrapical and hydrogeological information is very limited. (Author's abstract)
W87-05853

INFLUENCE OF IRON SOURCE ON THE WATER-HOLDING PROPERTIES OF POTTING MEDIA AMENDED WITH WATER-ABSORBING POLYMERS,
Victoria Dept. of Agriculture and Rural Affairs, Ferntree Gully (Australia). Horticultural Research Inst.
For primary bibliographic entry see Field 3F.
W87-05883

2G. Water In Soils

COMPARISON OF TWO COMPUTER MODELS FOR PREDICTING SOIL WATER IN A TROPICAL MONSOON CLIMATE,
Universidade Federal de Pernambuco, Recife (Brazil). Centro de Energia Nuclear.
C. Carneiro Da Silva, and E. DeJong.
Agricultural and Forest Meteorology, Vol. 36, No. 3, p 249-262, February 1986. 3 fig, 5 tab, 19 ref.

Descriptors: *Tropical regions, *Model studies, *Performance evaluation, *Hydrologic budget, *Computer models, *Soil water, Darcy's Law, Crops, Brazil, Drainage, Precipitation, Evaporation, Transpiration, Prediction, Runoff, Estimating Evapotranspiration, Roots, Canopy.

A physical soil water model, based on Darcy's law and the continuity equation and a water budget model were tested for three crops grown in the humid coastal zone of northeastern Brazil. Both models required daily information on precipitation, Class A pan evaporation, and used Soil Conservation Service curves to estimate runoff. Crop

canopy and rooting characteristics were similar for both models. Both models predicted soil water that compared favorably with measured values, and predicted evapotranspiration and drainage were probably superior to estimates from water balance calculations based on periodic measurements of soil water content and suction. The water budget model would have been improved if the field capacity had been based on the highest measured water contents in the rainy season. The models were more sensitive to rooting depth than to root distribution. Rate of canopy development had little effect on predicted drainage and evapotranspiration, but significantly changed the ratio of evaporation to transpiration. (Author's abstract)
W87-05279

PARTICLE-SIZE DISTRIBUTION METHOD FOR ESTIMATING UNSATURATED HYDRAULIC CONDUCTIVITY OF SANDY SOILS,
North Dakota State Water Commission, Bismarck.
W. M. Schuh, and M. D. Sweeney.
Soil Science SOSCAK, Vol. 142, No. 5, p 247-254, November 1986. 5 fig, 3 tab, 15 ref.

Descriptors: *Hydraulic conductivity, *Soil water movement, *Permeability coefficient, *Sand, *Soil saturation, *Particle size, Soil water potential, North Dakota, Soil profiles, Field tests, Estimating, Estimating equations.

A simple empirical method (J and T method) for estimating soil hydraulic conductivity based on soil water matric potential for sandy soils using only particle size information against in situ hydraulic conductivity values for seven sandy soil profiles in eastern North Dakota was tested and compared with an alternative method. On a composite of all data, the J and T method accounted for 60% of variability when compared with field values. Within a single soil series and within individual soil profiles, better than 80% agreement between predicted and actual hydraulic conductivity values was obtained in five of seven profiles with log-log calibration of the series or profile using the J and T method. In all cases, results using this method were comparable to or better than those determined using the method of Brooks and Corey with a field determined matching value. Both methods adequately characterized the variability of soil hydraulic conductivity when compared with in situ determinations. (Author's abstract)
W87-05295

ANALYSIS OF THE PERCOLATION TEST BASED ON THREE-DIMENSIONAL SATURATED-UNSATURATED FLOW FROM A CYLINDRICAL TEST HOLE,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
D. E. Elrick, and W. D. Reynolds.
Soil Science SOSCAK, Vol. 142, No. 5, p 308-321, November 1986. 12 fig, 43 ref.

Descriptors: *Percolation tests, *Saturated flow, *Soil disposal fields, *Unsaturated flow, *Test holes, *Flow measurement, *Permeability coefficient, Capillarity, Mathematical equations, Fluctuations, Spatial distribution, Hydraulic properties, Wastewater facilities, Site selection.

A new analysis of the percolation test based on three-dimensional, saturated-unsaturated flow theory is developed that accounts for capillarity, hole radius and water depth and explains much of the anomalous behavior previously observed in percolation rates. This analysis identifies the field-saturated hydraulic conductivity and matric flux potential rather than percolation rate as the main soil hydraulic properties relevant in determining site suitability and filter field design for wastewater facilities. Procedures are suggested for determining field-saturated hydraulic conductivity and matric flux potential and for dealing with spatial variability. (Author's abstract)
W87-05296

ENVIRONMENTAL PARAMETERS REGULATING GASEOUS NITROGEN LOSSES FROM TWO FORESTED ECOSYSTEMS VIA NITRIFICATION AND DENITRIFICATION,
North Carolina State Univ. at Raleigh. Dept. of Forestry.
E. A. Davidson, and W. T. Swank.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1287-1292, December 1986. 5 fig, 2 tab, 23 ref. NSF Grant BSR-8400833.

Descriptors: *Nutrients, *Watersheds, *Forests, *Nitrogen loss, *Diffusion, *Nitrification, *Denitrification, Soil water, Soil temperature, Nitrates, Streams, Transformation, Rainfall, Soil solution.

Studies of gaseous nitrogen losses from agricultural systems are abundant, but few studies have addressed losses from forested ecosystems. Difficulty in carrying equipment into forested sites has hampered these efforts, but the paucity of studies in forested relative to agricultural ecosystems also results from differences in the economic value of determining the fate of N. Gaseous N losses from disturbed and reference forested water sheds at the Coweeta Hydrologic Laboratory in western North Carolina were studied by in situ N2O diffusion measurements and laboratory incubations throughout a 10-month period. Soil temperature, percent base saturation, and water-filled pore space accounted for 43% of the variation in in situ N2O diffusion measurements. Laboratory incubations distinguished the gaseous N products of nitrification and denitrification. Nitrifying activity, ambient NO3(-), and nitrification N2O were positively correlated with percent base saturation. However, differences between watersheds in soil N substrate caused by presence of leguminous black locust in the disturbed watershed were confounded with differences in soil acidity. Denitrification was most strongly affected by soil moisture, which in turn was determined by precipitation events and slope position. Gaseous N losses from well-drained midslope and toeslope landscape positions appeared to be minor relative to other N transformations. Favorable conditions for denitrification occurred at a poorly drained site near the stream of the disturbed watershed. Laboratory incubations revealed high rates of NO3(-) reduction in these soils. We speculate that the riparian zone is a major site of depletion of NO3(-) from the soil solution via denitrification. (Alexander-PTT)
W87-05394

WATER AND CHLORIDE MOVEMENT THROUGH A LAYERED FIELD SOIL,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 5B.
W87-05414

SUSPENSION CONCENTRATION EFFECTS ON DEPOSITIONAL CRUSTS AND SOIL HYDRAULIC CONDUCTIVITY,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
I. Shainberg, and M. J. Singer.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1537-1540, November-December 1986. 3 fig, 3 tab, 5 ref.

Descriptors: *Permeability coefficient, *Infiltration, *Path of pollutants, *Soil columns, *Leaching, *Soil properties, *Percolating water, *Irrigation effects, Soil crusts, Soil surfaces, Clay dispersion, Salinity, Silt, Irrigation.

Surface irrigation, the most widely used irrigation method in the world, may cause soil erosion in furrows and basins, and the suspended solids concentration (predominantly clay and silt particles) may exceed 1%. Depositional crusts form when turbid water infiltrates into soils. These crusts may reduce water infiltration rates. The effect of four concentrations of fine particles (0, 0.25, 0.5, and 1.0%) and two electrolyte concentrations (0.001 M and 0.005 M Cl(-) on water infiltration rate was studied. Infiltration and hydraulic conductivity (HC) of two nonsodic soils were not affected by leaching with the salt solutions because the electrolyte concentration in the percolating water was sufficient to prevent clay dispersion and swelling in the soils. The clay and silt that deposited at the soil surface decreased the water infiltration rate. The HC of the depositional crust was 2 and 3 orders of magnitude less than the HC of bulk soils in the 0.005 M and 0.001 M solutions, respectively. The rate of crust formation and the decrease in infiltration rate increased with increase in the solids concentration. Applying a -1.5 kPa potential reduced crust HC but had no effect on soil HC. The effect of a potential was more pronounced on the crust deposited from the 0.005 M suspensions than on crust deposited from 0.001 M suspensions. (Alexander-PTT)
W87-05419

IRRIGATION MANAGEMENT FOR SOIL SALINITY CONTROL: THEORIES AND TESTS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 3C.
W87-05420

EVALUATION OF GREEN ASH ROOT RESPONSES AS A SOIL WETNESS INDICATOR,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
B. J. Good, S. P. Faulkner, and W. H. Patrick.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1570-1575, November-December 1986. 5 tab, 36 ref. COE Contract DACW 39-81-6-0032.

Descriptors: *Wetlands, *Bioindicators, *Soil water, *Green ash, *Irrigation effects, *Model studies, *Roots, Enzymes, Soil types, Rhizosphere, Respiration, Performance evaluation.

The unique properties and ecological importance of wetlands have stimulated keen interest in the development of reliable and efficient indicators of soil wetness. Because of the long recognized relationship between the floristic composition of a site and soil wetness, there has been much effort towards developing methods to delineate wetlands based on plant communities. Green ash (Fraxinus pennsylvanica Marsh.) seedlings were transplanted to plots along four bottomland hardwood transects in Louisiana which represent a wide range of soil-moisture and flooding regimes, and include the following soil series: Arkabulta (Aeric Fluvaquents, Rosebloom (Typic Fluvaquents), Norwood (Typic Udifluvents), Moreland (Vertic Hapludolls), Tensas (Vertic Ochraqualfs), Kobel (Vertic Haplaquepts), Goldman (Aquic Hapludalfs) and Fausse (Typic Fluvaquents). Each plot was classified as 'wet' or 'mesic' based on soil wetness data. Root-coating constituents (Al, As, Ca, Fe, K, Mn, Ni, P, and Zn) and alcohol dehydrogenase (ADH) activity of the seedlings were assayed after 1.5 yr. A two-group discriminant analysis function was developed in order to determine how well the seedling root data would predict the predetermined site-wetness category of each seedling's plot. The deposition of root-coating constituents and anaerobic respiration were distinct enough between the seedlings of the wet and mesic sites to be useful in the development of a fairly reliable model for site-wetness classification. The percentages of seedlings correctly grouped into the mesic and wet categories were 88.9 and 92.0, respectively. The variables chosen for inclusion in the discriminant analysis function, in descending order of predictive power, were K, Fe/Mn, Ni, Mg, ADH, and Mn. (Alexander-PTT)
W87-05421

USE OF THE HOOGHOUDT FORMULA FOR DRAIN SPACING CALCULATIONS IN HOMOGENEOUS-ANISOTROPIC SOILS,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
L. K. Smedema, A. Poelman, and W. De Haan.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 283-291, December 1985. 4 fig, 1 tab, 5 ref.

Descriptors: *Soil water movement, *Groundwater movement, *Drain spacing, *Hooghoudt formula, *Mathematical equations, Anisotropy, Drainage practices, Soil types, Isotropy, Laplace equation, Comparison studies, Mathematical studies, Numerical analysis.

Cases of groundwater flow in anisotropic soils can be transformed to equivalent isotropic cases, and then be solved with the Laplace equation. On the basis of this principle, the Hooghoudt formula, developed for isotropic soils, was used for calculating drain spacings in anisotropic soils. However, the Hooghoudt formula is only an approximate solution of the Laplace equation so that the extension to anisotropic soils may not a priori be justified under all conditions. Results obtained with the Hooghoudt formula were compared to those obtained by numerical solutions of the Laplace equation. On the basis of this comparison, it was concluded that the Hooghoudt formula may indeed be used with reasonable confidence for drain spacing calculation in homogeneous-anisotropic soils. (Author's abstract)
W87-05433

CALCULATING THE QUALITY OF DRAINAGE WATER FROM NON-HOMOGENEOUS SOIL PROFILES WITH AN EXTENSION TO AN UNSATURATED-SATURATED GROUNDWATER QUALITY MODEL INCLUDING BYPASS FLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 2F.
W87-05434

PREDICTION OF SOIL MOISTURE CHARACTERISTICS FROM MECHANICAL ANALYSIS AND BULK DENSITY DATA,
Water and Land Management Training and Research Inst., Hyderabad (India).
N. Madankumar.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 305-312, December 1985. 1 fig, 5 tab, 12 ref.

Descriptors: *Soil water, *Moisture content, *Soil physical properties, *Density, *Mathematical equations, *Mathematical studies, Regression analysis, Soil properties, Silt, Clays, Saturation, Comparison studies, Soil types.

Soil moisture characteristics can be established directly from the physical properties of soils such as mechanical analysis and bulk densities. Multiple regression equations were worked out by taking first fractions of sand (E sub 1), silt + clay (E' = E sub 2 + E sub 3) and bulk density (P), and second fractions of sand (E sub 1), silt (E sub 2), clay (E sub 3) and bulk density (P) as independent variables to predict the parameter b, the air-entry potential psi sub e and the saturation moisture content theta sub s of the soil-moisture characteristics equation. Regression equations were tested for soils of different textural and structural compositions and showed good agreement between estimated and experimentally determined values. (Author's abstract)
W87-05435

DETERMINATION OF THE PERMISSIBLE AMOUNT OF LIQUID ANIMAL WASTE APPLIED TO SOIL FILTERS,
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnica.
For primary bibliographic entry see Field 5G.
W87-05436

AVOIDING OCHRE DEPOSITS IN SOIL DRAINAGE PIPES,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 4B.
W87-05437

LEACHING REQUIREMENT OF IRRIGATED SOILS,
Darling Downs Inst. of Advanced Education, Toowoomba (Australia). School of Engineering.
For primary bibliographic entry see Field 3F.
W87-05441

QUASI-STEADY STATE INTEGRAL MODEL FOR CLOSED-END BORDER IRRIGATION,
For primary bibliographic entry see Field 3F.
W87-05444

FIELD EVIDENCE FOR A BI-POROUS SOIL WATER REGIME IN CLAY SOILS,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental Unit.
A. C. Armstrong, and R. Arrowsmith.
Agricultural Water Management AWMADF, Vol. 11, No. 2, p 117-125, April 1986. 4 fig, 1 tab, 21 ref.

Descriptors: *Clays, *Soil water, *Field tests, *Model studies, *Neutron probes, Soil types, Water level, Auger holes, Mathematical models, Mathematical studies, Mathematical equations, Comparison studies.

A bi-porous model of the soil water regime is examined in the light of field data. It is proposed that the water level in macropores can be measured by auger holes, whereas the micropore component can be measured by the neutron probe. Field observations show rapid fluctuation in auger holes but only very slow changes in the neutron probe readings. These are in line with the predictions of the model which thus receives qualitative verification. (Author's abstract)
W87-05448

RUNOFF BEHAVIOUR OF WATER HARVESTING MICROCATCHMENTS,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2A.
W87-05450

WATER BALANCE AND PATTERN OF SOIL WATER UPTAKE IN A PEACH ORCHARD,
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
For primary bibliographic entry see Field 2D.
W87-05451

TRICKLE IRRIGATION OF COTTON: EFFECT ON SOIL CHEMICAL PROPERTIES,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
For primary bibliographic entry see Field 3F.
W87-05452

FLUORIDE ADSORPTION BY A SALINE SODIC SOIL IRRIGATED WITH A HIGH F WATER,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 5B.
W87-05508

QUASI-STEADY STATE INTEGRAL MODEL FOR BORDER IRRIGATION,
For primary bibliographic entry see Field 3F.
W87-05509

PHYSICALLY-BASED FOREST HYDROLOGY MODEL I: DEVELOPMENT AND SENSITIVITY OF COMPONENTS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
D. L. Thomas, and D. B. Beasley.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 962-972, July-August 1986. 13 fig, 1 tab, 49 ref. USDA-FS Grants 19-81-54 and 19-82-063.

Descriptors: *Rainfall-runoff relationships, *Forest hydrology, *Model studies, *Soil porosity, *Percolation, *Mathematical models, *Sensitivity analysis, *Seepage flow, *Simulated runoff, *Infiltration, *ANSWERS, Watersheds, Forests, Hydrology, Equations, Computers, Agriculture.

A physically-based forest hydrology model was developed which utilizes the forest soil characteristics of macropore and seepage flow and the partial contributing area affect. The simulated runoff is most affected by variations in the depth to an impeding layer in the soil, the control zone used for infiltration and the percolation rate through the impeding layer. (See also W87-05523) (Author's abstract)
W87-05522

FINITE ELEMENT MODEL OF FLOW TO AN AUGER HOLE IN LAYERED SOILS,
Agricultural Research Service, Baton Rouge, LA.
J. S. Rogers.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1005-1011, July-August 1986. 4 fig, 6 tab, 10 ref.

Descriptors: *Model studies, *Flow, *Hydraulic properties, *Mathematical models, *Performance evaluation, *Mathematical analysis, *Water table, *Permeability coefficient, Auger holes, Soil layers, Soil profile, Prediction, Sensitivity.

A finite element model of flow to an anger hole was developed. The model gives the same values of the shape factor C for uniform soils as the exact mathematical solution. The model was then expanded to layered soil systems to show that properly selected combinations of hole depth, water table depth, and depth of water removed from the hole may be used to determine the hydraulic properties of individual soil layers. (Author's abstract)
W87-05527

FURROW MODEL WITH SPATIALLY VARYING INFILTRATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. W. Wallender.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1012-1016, July-August 1986. 7 fig, 1 tab, 14 ref.

Descriptors: *Furrow irrigation, *Model studies, *Mathematical models, *Water use efficiency, *Infiltration, *Spatial variability, Irrigation, Equations, Performance evaluation, Comparison studies.

A furrow irrigation model, using volume balance equations, was solved assuming constant space steps to accommodate spatially varying infiltration characteristics. Before assessing the influence of variable infiltration characteristics, the model was compared with a similar recursive model with constant time steps (Hall, 1965) and the results agreed. Nonuniform infiltration characteristics reduce Christiansen's uniformity coefficient, CU, more than nonuniform intake opportunity time for the conditions tested. Further, soil related variability reduces CU more than it reduces water application efficiency. (Author's abstract)
W87-05528

SYSTEM FOR MEASURING INFILTRATION RATES UNDER CENTER-PIVOT IRRIGATION SYSTEMS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W87-05536

WATER-TABLE LEVEL EFFECT ON THE YIELD OF IRRIGATED AND UNIRRIGATED GRAIN MAIZE,
Consiglio Nazionale delle Ricerche, Naples (Italy). Irrigation Inst.
A. Alvino, and G. Zerbi.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1086-1089, July-August 1986. 6 fig, 22 ref.

Descriptors: *Water table, *Crop yield, *Grain crops, *Irrigation, *Field tests, Plant growth, Corn, Moisture content, Seeds, Reproduction, Vegetation, Growth.

Field studies were conducted to obtain data on the effect of a water table on a grain maize crop, grown in rainfed and irrigated conditions. The data showed that grain yield decreased as water-table depth increased with the change being more rapid in rainfed than in irrigated conditions. Grain mois-

ture content and individual seed weight were linearly related to water-table depth, but both independent of the water regime. The differences in yield between the water regimes were due to the number of seeds per ear at shallow water-table depth and to the percentage of sterile plants at the deep water-table levels. Plant height decreased as water-table depth increased. Leaf senescence was lower in plants grown at shallower water-table levels. (Author's abstract)
W87-05539

CADMIUM AND ZINC INFLUX CHARACTERISTICS BY INTACT CORN (ZEA MAYS L.) SEEDLINGS,
Auburn Univ., AL. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 5B.
W87-05591

EFFECTS OF APPLICATION PROCEDURES AND IRRIGATION ON DEGRADATION AND MOVEMENT OF ALDICARB RESIDUES IN SOIL,
Wisconsin Univ.-Madison. Dept. of Entomology.
For primary bibliographic entry see Field 5B.
W87-05621

PROCEEDINGS OF THE ISSS SYMPOSIUM ON WATER AND SOLUTE MOVEMENT IN HEAVY CLAY SOILS.
International Society of Soil Science, Wageningen (Netherlands).
For primary bibliographic entry see Field 2F.
W87-05665

DEVELOPMENT OF STRUCTURAL AND MICROFABRIC PROPERTIES IN SHRINKING AND SWELLING CLAYS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 8D.
W87-05666

MECHANICS OF COLLOIDAL SUSPENSIONS WITH APPLICATION TO STRESS TRANSMISSION, VOLUME CHANGE, AND CRACKING IN CLAY SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 8D.
W87-05668

EXTENT AND DYNAMICS OF CRACKING IN A HEAVY CLAY SOIL WITH XERIC MOISTURE REGIME,
Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
For primary bibliographic entry see Field 8D.
W87-05669

EVOLUTION OF CRACK NETWORKS DURING SHRINKAGE OF A CLAY SOIL UNDER GRASS AND WINTER WHEAT CROPS,
Centre de Recherches d'Avignon, Montfavet (France).
For primary bibliographic entry see Field 8D.
W87-05670

CRACKING PATTERNS IN SOILS CAUSED BY SHRINKING AND SWELLING,
Hanover Univ. (Germany, F.R.). Inst. fuer Bodenkunde.
K. H. Hartge.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 55-58, 3 fig, 2 ref.

Descriptors: *Soil cracking, *Soil moisture retention, *Soil swelling, *Soil shrinking, *Mathematical analysis, Soil aggregates, Mathematical studies, Drying.

Angles formed on drying and wetting of clay slurries in the laboratory showed markedly different patterns for different soils. Observations on in situ aggregates are reported and compared with the laboratory results. The distributions of the angles of all the samples had irregular shapes. A prevailing frequency-maximum at 90 degrees was not always distinguishable. The fraction of angles allottable to the 90 degree distribution varied. The deviations of the mean values of the two 'nonreactangular' distributions from 90 degrees were nearly equal. The sum of the mean values of these two distributions was close to 180 degrees (8 out of 11 were between 177,5 degrees and 182,5 degrees). The higher the portion of 90 degree angles from the total of all values of a sample was the lower the deviation of the rest of them was from 45 degrees. From the cracking pattern studied, it can be seen that the nonrectangular angles originate from forces normal to the direction of the elder primary cracks. If the forces were active tangential to the primarily developed crack, then the smaller angles should have distributions with peaks at < 45 degrees. (See also W87-05665) (Lantz-PTT)
W87-05671

CRACK FORMATION IN NEWLY RECLAIMED SEDIMENTS IN THE IJSSELMEER POLDERS,
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
K. Rijniersce.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 59-62, 1 fig, 3 ref.

Descriptors: *Soil chemistry, *Sediments, *Land reclamation, *IJsselmeer polders, *Polders, *Soil water, *Model studies, The Netherlands, Clays, Evaporation, Soil properties, Permeability, Simulation analysis, Drying.

In the former ZuyderZee - now called IJsselmeer - four polders have been reclaimed. Just after reclamation, the clayey sediments in these polders can be characterized as very soft and wet, and unsuited for agricultural production. Although the pore volume is high, there are no larger pores and so the soil is virtually impermeable, making drainage impossible. By a process, called soil ripening, the sediments are transformed into normal soils, very suitable for agricultural use. The physical part of this process starts as soon as the water is pumpped out of the polder. Due to the evaporation surplus in summer under the Dutch climatic conditions, the water content decreases and the compaction of the soil leads to subsidence and crack formation. By the newly developed cracks, the permeability of the soil increases so that water can be drained away. The compaction of the soil is almost completely irreversible. Recently, a simulation model for this process has been developed. A specific problem during this development was the simulation of the crack formation. A submodel was developed for the simulation of subsidence and crack formation which produced results in good agreement with those obtained in field studied. (See also W87-05665) (Lantz-PTT)
W87-05672

TECHNIQUE FOR THE DESCRIPTION OF THE CRACK PATTERN AND FOR PREDICTING THE HYDRAULIC EFFICIENCY OF HEAVY SOILS,
Design and Construction Inst. of the Czechoslovak Ceramic Industries, Prague.
F. Dolezal, S. Hrin, R. Mati, J. Harmoci, and M. Kutilek.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 63-66, 1 fig.

Descriptors: *Soil cracking, *Hydraulic properties, *Soil water, *Mathematical analysis, Mathematical studies, Hydraulic permeability, Drying, Hydraulic models, Permeability coefficient, Quantitative analysis, Mathematical models.

Dessication cracks are only a part of the complex macrostructure of heavy soils. Their hydrological role has been recognized and continues to be a subject for attempts at quantitative simulations. An attempt was made to describe the cracks in soils quantitatively, by the direct measurement of the length of the cracks in a section. The assumption about the vertical direction of cracks was often accepted. No attempt has been made at the quantification of the anisotropy of the pattern. A technique was developed for the description of cracks based upon the Saltykov's method of directed secants, together with a simple geometric and hydraulic model, allowing the approximate calculation of hydraulic conductivity, as well as of other transport properties, under arbitrary boundary conditions. Preliminary experimental studies show that this method can give reasonable results, if it is supplied with reliable data and if the results are slightly calibrated for individual pedons. It is suitable for the assessment of the hydrological behavior of large cracks, visible with the naked eye, where the problem of the connectivity of macropores usually does not occur. The model is open to refinements, to applications for other transport processes and for the prediction of hydraulic conductivity changes with changing soil moisture content. (See also W87-05665) (Lantz-PTT)
W87-05673

VARIATIONS IN HYDRAULIC CONDUCTIVITY UNDER DIFFERENT WETTING REGIMES,
Silsoe Coll. (England).
P. B. Leeds-Harrison, and C. J. P. Shipway.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 67-70, 5 fig, 5 ref.

Descriptors: *Hydraulicc conductivity, *Drainage, *Permeability coefficient, *Soil water, *Soil fissures, *Soil moisture retention, Soil shrinking, Soil swelling, Quantitative analysis, Mathematical analysis, Saline soils, Leaching, Hydrographs.

The importance of soil fissures for the effective drainage of clay soils has been previously demonstrated. It is recognized though, that soil fissures change their dimensions with the swelling and shrinkage of the soil peds. This results in a change in the hydraulic characteristics of the soil. A quantitataive assessment of this change and how it relates to the water movement in a swelling soil is presented. Calculated values of macroporosity are generally two orders of magnitude smaller than the measured values. This has implications for the reclamation of saline soils as the predominant leaching process will only occur in the macropores in which there is moving water. In these situations rapid fluctuations of the water table would be preferable to longer ponding of water as the peds would have a short opportunity time for swelling, the hydraulic conductivity would not fall, and a greater movement of water within the profile would be possible with a consequent increase in leaching. In mole-drainage studies, the hydraulic conductivity and specific yield can be used with the appropriate boundary conditions to predict the drain flow hydrograph. This has been done with the data presented here and the characteristically peaked hydrography is predicted. As expected higher flow rates are predicted with the rapidly wetted soil data than with the slowly wetted soil data. (See also W87-05665) (Lantz-PTT)
W87-05674

STRUCTURAL CHANGES IN TWO CLAY SOILS UNDER CONTRASTING SYSTEMS OF MANAGEMENT,
Aberdeen Univ. (Scotland). Dept. of Soil Science.
L. A. Mackie, C. E. Mullins, and E. A. FitzPatrick.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 71-77, 6 fig, 1 tab, 5 ref.

Descriptors: *Clays, *Soil moisture, *Cruden Bay, *Scotland, *Compton Beauchamp, *England, *Infiltration, *Soil structure, Soil properties, Plowing, Drilling, Macroporosity, Drying, Soil moisture retention.

The structure of clay soils can have great importance for infiltration, drainage and root growth. Because structure changes throughout the growing season can vary from year to year, and is influenced by cultivations and the type of crop, it is difficult to study and characterize. In this study, an attempt is made to obtain a composite picture by combining many different methods. Two contrasting locations, Cruden Bay (Aberdeenshire) in North East Scotland, and Compton Beauchamp (Oxfordshire) in the South of England, were chosen. Three sites chosen at Cruden Bay, at different stages of a 7-yr rotation, were sampled throughout two growing seasons. The structural effects of ploughing and direct drilling were compared with permanent grazing on the Denchworth series at Compton Beauchamp during one growing season. Although there were many differences between the two locations, there were also many similarities in structural change. In all ploughed sites, the structure of the surface 0 to 10-cm zone was composite subangular blocky/granular just after seedbed preparation and settled continually until it was recultivated. In both locations, planar, irregular, and circular macropores developed on shrinkage and blocky and wedge structures were formed. Changes in the macroporosity throughout the sampling period were often closely related to changes in volumetric water content, especially in the non-cultivated sites. The effects of earthworm activity on the soil structure were also cyclic in nature, corresponding to their pattern of annual activity. At Compton Beauchamp, all sites had many vertical, sinuous and crescentic macropores and earthworm channels in July 1981, probably formed after April, but before the severe drying period in July. The effect of earthworms on the soil structure was also evident on the sites at Cruden Bay. These results illustrate the dynamic nature of clay soils. A sequence of processes, both artificial and anthropogenic, have resulted in a corresponding sequence of structural states. (See also W87-05665) (Lantz-PTT)
W87-05675

EFFECT OF AL-HYDROXYDE ON THE STABILITY AND SWELLING OF SOIL (CLAY) AGGREGATES,
Magyar Tudomanyos Akademia Talajtani es Agrokemiai Kutatointezete, Budapest.
A. Muranyi, and M. G. M. Bruggenwert.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 78-81, 5 fig.

Descriptors: *Aluminum hydroxide, *Soil moisture, *Soil stability, *Soil aggregates, *Soil swelling, Permeability coefficient, Electrical conductivity, Adsorption.

Hydraulic conductivity of soils is a function of structure. Structural stability as well as pore size distribution is, in turn related to chemical characteristics. In this context, soil solution electrical conductivity (EC), composition of the adsorption complex (ESP) and the presence of cementing agents are important parameters. The role of cementing agents, has received less attention than the EC and ESP. This research was directed toward contributing to the characterization of Al hydroxde influence on structure stability and swelling properties of soil (clay) aggregates. As expected, intrinsic permeability (K sub i) values decrease with decreasing EC and increasing ESP. The study also indicated that the stability of the aggregates is improved with an increasing mutual coagulation factor. (See also W87-05665) (Lantz-PTT)
W87-05676

CHANGE OF STRUCTURE AND FABRICS OF CLAY ALLUVIAL SOILS UNDER AGRICULTURE,
Moscow State Univ. (USSR).
S. A. Avetjan, B. G. Rozanov, and N. G. Zborishuk.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 82-85, 2 fig, 1 tab.

Descriptors: *Soil structure, *Clays, *Alluvial soils, *Irrigation effects, Agriculture, Soil properties, Humus, Calcium, Sodium, Hydrogen ion concentration, Leaching, Soil swelling, Soil shrinking.

Agricultural utilization under irrigation of heavy clay montmorillonitic alluvial soils often leads to a rather sharp decline of their productivity due to loss of the original structure and development of vertic properties. This phenomenon was studied in an area where meadow alluvial soils were brought to cultivation ten years ago. These soils contain 45-60% of predominantly montmorillonitic clay, 3-4% of humus; they have CEC of about 35-40 milliequivalents/100 gm, dominated by calcium with sodium content not exceeding 5% of CEC. Their pH is 7.0-7.5. Destruction of the original structure of these soils as a result of cultivation may be attributed to: (a) decrease of the humus content by 10-20%; (b) leaching of the water soluble salts (the virgin soils are slightly saline from the surface; (c) repeated mechanical soil treatment when soils are too wet or too dry; (d) modification of soil aggregates under alternation of swelling and shrinkage in the moistening-drying cycles; re-orientation and repacking of highly dispersed clay particles. (See also W87-05665) (Lantz-PTT)
W87-05677

DISTRIBUTION FUNCTION MODEL OF CHANNELLING FLOW IN SOILS BASED ON KINEMATIC WAVE THEORY,
Institute of Hydrology, Wallingford (England).
K. Beven, and P. Germann.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 89-100, 4 fig, 7 ref. EPA Agreement No. R810456-01-0.

Descriptors: *Soil water movement, *Groundwater movement, *Flow channels, *Kinematic wave theory, *Distribution analysis, Model studies, Macroporosity, Mathematical analysis, Mathematical equations.

A further development of the kinematic wave approach to modelling flow through macropores or channels in the soil is presented. The macroporosity is assumed to take the form of a number of essentially independent flow paths of unknown geometry. In each pathway, a power law relationship between water content and flow velocity is assumed to describe adequately flow conditions in the channels. Variation between the pathways is ascribed to variation in the coefficient of the power law relationship. A probability distribution associated with this coefficient may be derived from experiments on soil columns. Analytical equations for each flow pathway are presented. The model is used to predict the results of experiments on undisturbed soil columns. (See also W87-05665) (Author's abstract)
W87-05678

MATHEMATICAL MODELS OF WATER MOVEMENT IN HEAVY CLAY SOILS,
Akademiya Nauk SSSR, Moscow. Inst. of Soil Science and Photosynthesis.
Y. A. Pachepsky, and N. G. Zborischuk.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 101-113, 3 fig, 18 ref.

Descriptors: *Mathematical models, *Soil water movement, *Groundwater movement, *Clays, Agriculture, Irrigation effects, Soil management, Soil moisture retention, Permeability coefficient, Soil shrinking, Soil swelling, Geohydrology, Mathematical studies.

To increase agricultural productivity of heavy soils, by irrigation in particular, it is necessary to predict the moisture regime of the root zone. The peculiar features of heavy clay soils (swelling-shrinking, crack formation, the narrow range of available water, low hydraulic conductivity) manifest themselves depending to a large extent on weather conditions. That is why observational data on moisture in situ cannot be directly used for predictions which require consideration of different possible combinations of weather and hydrogeological conditions and land reclamation measures. In this situation, mathematical modelling appears to be of great help as an addition to other methods of soil research. The moisture regime prediction can be obtained on the basis of an adequate mathematical model. An example of the construction of such a model, as applied to the clay alluvial soils of an alfalfa field, is given. (See also W87-05665) (Lantz-PTT)
W87-05679

SOME THEORETICAL AND PRACTICAL ASPECTS OF INFILTRATION IN CLAYS WITH D = CONSTANT,
Ceske Vysoke Uceni Technicke v Praze. Soil Science Lab.
M. Kutilek.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 114-128, 2 fig, 4 tab, 18 ref.

Descriptors: *Theoretical analysis, *Infiltration, *Clays, *Diffusivity, *Soil water, *Mathematical analysis, Electrical conductivity, Permeability coefficient, Sodium, Mathematical equations.

With increasing alkalinity of clays when the exchangeable sodium percentage (ESP) rises and the electrical conductivity (EC) is kept at low values, the relationship between the water diffusivity (d) and the soil moisture (theta) starts to be less nonlinear, approaching a constant value. The physical parameters of a model soil (saturated hydraulic conductivity, relative unsaturated hydraulic conductivity, pressure head, moisture retention curve) with D = constant, are discussed and compared to the observed values. Crusting of the surface due to rain was included in an approximate model with D = constant on the surface of the clay soil and the induced shift of the ponding time was examined. (See also W87-05665) (Lantz-PTT)
W87-05680

HYDRAULIC CONDUCTIVITY AND STRUCTURE OF THREE AUSTRALIAN IRRIGATED CLAYS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
J. M. Cooper.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 129-132, 2 tab, 1 ref.

Descriptors: *Permeability coefficient, *Australia, *Irrigation effects, *Clays, *Soil water, *Kerang, *Benerembah, *Narrabri, Soil swelling, Soil saturation, Water table, Infiltration, Soil salinity.

Swelling clay soils are widespread in the eastern Australian hinterland, occupying about 10 to the 8th ha of alluvial plains. In the management of irrigated swelling soil, hydraulic conductivity in the swollen ('saturated') state is significant for profile drainage, salt leaching, and the re-establishment of aerobic root zone conditions following irrigation or heavy rainfall. Three sites on irrigated areas of alluvial plains are studied, with the aim to examine the relationship between hydraulic conductivity, structure and macroporosity. At Kerang, irrigated creal cropping (not rice) and pasture production, which began some 80 years ago, soon led to shallow water tables and salinization of the soil. At Benerembah the area has been irrigated for some 25 years, mainly for rice, other cereals and pasture, and the water table is at 10-15 m and

rising. At Narrabri, irrigation began about 20 years ago for cotton production, and since then some soil structural degradation has occurred as a result of tillage and other cropping operations. Water tables do not occur. The identification of cylindrical rather than planar voids as the significant patheways for saturated waterflow in the Kerang soil, provides an explanation for the rapid development of water tables and consequent salinity following the advent of irrigation. The Beneremban soil presents a more difficult management problem. Porosity created by deep ripping or deep ploughing in an attempt to improve water entry into, and drainage from, the profile is unlikely to persist for long because of high subsoil exchangeable sodium percentage (ESP) values. Massive doses of gypsum would be required to lower the profile sodicity levels appreciably. The Narrabari soil with low ESP values, might be expected to benefit from deep tillage because the porosity created is likely to be persistent and provide the needed rootzone drainage for re-establishing aerobic conditions after irrigation and rain. In this soil, unlike the others, mole drainage could perhaps be useful. (See also W87-056765) (Lantz-PTT)
W87-05681

RAPID CHANGES IN SOIL WATER SUCTION IN A CLAYEY SUBSOIL DUE TO LARGE MACROPORES,
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Bodenkunde.
H. H. Becher, and W. Vogl.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 133-136, 1 fig, 4 ref.

Descriptors: *Soil water, *Clays, *Soil water suction, *Subsoil, *Soil horizons, *Bavaria, Macroporosity, Silt, Sand, Wheat, Corn, Barley, Soil moisture tension, Permeability coefficient, Loess.

Monitored soil water tensions in the Tertiary Hill Country of Southern Bavaria, during the growing seasons 1978-1980, showed unexpectedly rapid changes. The soil in this area is an Aquic Chromudert derived from Tertiary calcareous (up to 57% carbonates) clay (37-62% clay, 22-41% silt, 4-22% sand) overlain by a thin loess layer (28% clay, 39% silt, 33% sand). Smectites dominate in the Tertiary clay. During 1978-1980, the crops on the site were winter wheat, winter barley followed by rape as intercrop, and corn, respectively. The smoothed soil water tension/time curves for depths >85 cm showed a typical feature in the seasons 1978 and 1979. Soil water tensions slowly increased by about 200 cmWC within 3-6 wks, and rapidly decreased by the same amount within 7-10 days. In 1980, due to much precipitation during the first growing stages of corn (which is well developed late in the season), soil water tensions were near or below 0cmWC in all depths until corn was well developed. Periods with high precipitation coincided in 1978 and 1979, with a large decrease of soil water tension at all depths. The low unsaturated hydraulic conductivities of the upper horizons even at low soil water tensions cause most of the water of a higher precipitation following a dry period to flow downward, along the walls of the cracks developed during the dry period, and not into the aggregates of the upper horizons. The very large changes of soil water tension (e.g. 260 cmWC in the range between 100 and 400 cmWC) due to a small change in water content (2%b.v. H2O) of the horizons >85 cm depth, also cause a rapid decrease in the soil water tension in the subsoil horizons. After harvest when evapotranspiration is strongly reduced, soil water tensions within rooting depth decreased to about 30-50cmWC for the rest of the year. Although the aggregates of the upper horizons swelled to some extent due to wetting up of the soil, the cracks are more or less intact in the surface soil as well as in the subsoil. (See also W87-05665) (Lantz-PTT)
W87-05682

RAINFALL INFILTRATION INTO SWELLING SOILS,
Instituto Nacional de Investigaciones Agrarias, Cordova (Spain).
For primary bibliographic entry see Field 2A.
W87-05683

FIELD EVIDENCE FOR A TWO-PHASE SOIL WATER REGIME IN CLAY SOILS,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental Unit.
A. C. Armstrong, and R. Arrowsmith.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 142-147, 3 fig, 1 ref.

Descriptors: *Soil water, *Clays, *Soil water movement, *Field tests, *Macroporosity, Model studies, Permeability coefficient, Soil porosity, Soil water level, Neutron probe, Auger hole.

In clay soils, an important component of soil water movement is the network of paths for rapid movement termed 'macropores'. The division of water into two phases, of high and low mobility, has proved useful for modelling soil water regimes, by subdividing the soil into a system of high conductivity and low drainable porosity representing the macropores, and a second system with very low conductivity but high drainable porosity representing the soil matrix. The degree to which the behavior of the soil water system predicted by the model is reflected in observation was investigated. The data reveal that in a clay soil, there is a distinct difference in mode of behavior between water levels recorded in an open auger hole, and the profile water content measured by a neutron probe. This overall pattern is very similar to that predicted by the two-phase model. (See also W87-05665) (Lantz-PTT)
W87-05684

INFILTRATION OF WATER INTO CRACKED SOIL,
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
For primary bibliographic entry see Field 2A.
W87-05685

ROLE OF EARTHWORM CHANNELS IN WATER FLOW ON A DRAINED CLAY SOIL,
State Bureau for Land Reclamation, Prague (Czechoslovakia).
J. Urbanek, and F. Dolezal.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 152-155, 3 ref.

Descriptors: *Soil water movement, *Earthworm channels, *Water flow, *Clays, *Drainage, *Soil porosity, Lateral drains, Trenches, Permeability coefficient, Infiltration, Flow rate.

The geometry of tubular channels made by earthworms and their influence upon the drainability of a clay soil was investigated at Praha 4 - Opatov, on a meadow, with a drainage system installed 40 years ago. Soil type (according approximately to FAO classification) was Gleyic Luvisol, clayey, with approximately 50% of particles below 10 microns in topsoil and 70% in subsoil, wet, developed in quarternary deluvial sediments over ordovic shales. The lateral drains were laid manually into a trench that was 0,95 m deep, and 0,22 m wide at the bottom. Drain tiles of length 0,33 m were covered by humous soil material to a depth of about 0,15 - 0,20 m above the bottom, and the trench was further filled with mixed soil backfill material. The distance between lateral drains was 10 m. From the measurements of hydraulic conductivity on large soil cores (diameter 80 mm, height about 70 mm) with channels of earthworms in them, the hydraulic conductance of individual channels (with diameters about 7 mm) appeared to be about 8 cu cm/s. Apparently, the natural flow path of water into the drain was much more tortuous. Insufficient permeability of the joints themselves, partially clogged with soil, was the main reason for the reduction of flow rate. Nevertheless, the positive effect of earthworms upon the hydraulic properties of the backfill is evident. In the vicinity of the drain, the channels of earthworms ran parallel to the drain. (See also W87-05665) (Lantz-PTT)
W87-05686

SEASONAL CHANGES IN SOIL-WATER REDISTRIBUTION PROCESSES AFFECTING DRAIN FLOW,
Birkbeck Coll., London (England). Dept. of Geography.
I. Reid, and R. J. Parkinson.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 156-159, 1 fig, 2 tab, 5 ref.

Descriptors: *Seasonal variation, *Soil water movement, *Soil water, *Drainage patterns, *England, Drainage water, Clays, Silt, Sand, Gravel, Saturated soil, Permeability coefficient, Tile drainage.

Tile drain outfall was recorded over four drainage seasons, from 1977 to 1981, on a mixed arable/grass farm 18 km north of central London, U.K. Ground slopes vary from 0-5 degrees. The soil is a surface water gley (haplaqualf), and typically comprises 55% clay, 40% silt and 5% sand and gravel. Saturated hydraulic conductivity is variable, values of 0.001 m/s for the topsoil and 0.000001 m/s for the subsoil being representative. Drainflow was continuously recorded from two herring-bone type networks (26.5 and 6.0 ha) and six laterals, ranging in drainage area between 0.21 and 0.55 ha. Annual changes in soil water content in a cracking clay are shown to control the character of tile drain outfall through control of the mechanisms of soil water redistribution. Hydrographs generated by tile drain networks and simple tile laterals over a period of four drainage seasons are compared for: (a) winter versus non-winter storm differences, and (b) simple versus complex storm differences. The observed variations are large and related to prerainfall soil water contents and soil conditions. (See also W87-05665) (Lantz-PTT)
W87-05687

IMPACT OF WATER RELATIONS OF VERTISOLS ON IRRIGATION IN SUDAN (FIELD STUDIES ON GEZIRA CLAYS),
Gezira Univ., Wad Medani (Sudan).
O. A. Fadl.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 160-166, 3 fig, 6 ref.

Descriptors: *Vertisols, *Soil water, *Irrigation practices, *Gezira, *Sudan, Blue Nile River, Seasonal variation, Flooding, Soil salinity, Drying, Neutron probes, Gamma probes, Soil swelling.

The water relations of the vertisols in central Sudan have influenced every aspect of development of crop production and gravity irrigation. Of those fairly uniform soils the Gezira Scheme covers 900,000 ha which are irrigated from the Blue Nile by etensive canals, paradoxically, with no drainage system. Prior studies have concluded that irrigation in the Gezira with Blue Nile water for 55 years moved the salts downward, reduced exchangeable sodium and increased exchangeable calcium. In an experimental site at the Gezira Research Station flooding of dry plots in April gave net increases of between 1236 and 1562 cu m/ha of water stored to 110 cm depth. A second flooding of the same basins in May gave an average increase of 458 cu m/ha, while the third in July added 833 cu m/ha. By the end of July there was 1700 cu m/ha of available water to 100 cm depth. Field measurements showed that subsequent irrigations varied between 700 and 1500 cu m/ha. The rates of application depended on the crop, the season and the preceding period of drying. Thus mean water intake of those soils was primarily

influenced by the moisture content at the time of water application. The effect of moisture changes on dry density was measured with neutron and gamma probes in a field which was irrigated for the first time. Prior to flooding, the volumetric moisture content at 10 cm depth was 5.3%, and the dry density 1.33 g/cu cm. The moisture at 60 cm was 18% and the corresponding density 1.51 g/cu cm. After flooding and swelling, the volumetric moisture at 10 cm increased 44.9% and the dry density lowered to 1.17 g/cu cm. At 60 cm, the moisture reached 46% and the density 1.33 g/cu cm. The changes of the density of a layer depended on whether the swelling was free or confined and on the size of the overburden. Such changes which were caused by wetting and drying cycles on those soils resulted in the extensive crack characteristics of the cultivated areas. (See also W87-05665) (Lantz-PTT)
W87-05688

SEASONAL CHANGES OF HYDRIC AND STRUCTURAL BEHAVIOUR IN CLAY SOILS WITH SALINE WATERTABLES ON THE COAST OF LANGUEDOC, FRANCE,
Centre de Recherches de Montpellier (France).
J. C. Favrot, R. Bouzigues, and P. Lagcherie.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 167-170, 5 ref.

Descriptors: *Seasonal variation, *Soil salinity, *Water table, *Languedoc, *France, *Clays, *Soil structure, Salt pans, Soil shrinking, Soil swelling, Soil cracking, Soil porosity, Iron, Irrigation, Drainage.

In Languedoc, to the west of the 'Petit-Rhone' River, halomorphous clay soils take up nearly 25,000 ha. They are located in a flat area and often below sea level between the coastal salt pans, and the Mediterranean Sea. They are partly cultivated after important hydroagricultural works were carried out around 1960 (building of dikes, draining, pumping stations, irrigation). The regional climate, which is of the temperate Mediterranean type, causes wide seasonal fluctuation in soil water content and depth of water table. Swelling-shrinking movements result in pronounced cracking phenomena. The incidence of those structural and pore dynamics on the changes in consistency and on the translocation of clay, iron and salts, was studied at drainage experimental fields. The clear evolution of structural behavior caused by rainfall and water table fluctuation from one season to another, was accomplished by solid phase and solute transport, as well as biochemical processes and affected directly the efficiency of the irrigation and drainage system. (See also W87-05665) (Lantz-PTT)
W87-05689

WATER REGIME OF A MOLE DRAINAGE EXPERIMENT ON A HEAVY CLAY SOIL OF THE SOLOGNE AREA (FRANCE),
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
B. Lesaffre, M. Normand, and G. Valencia.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 171-177, 1 fig, 5 tab, 13 ref.

Descriptors: *Mole drainage, *Soil drainage, *Clays, *Sologne, *France, *Soil water, Drainage systems, Soil structure, Plasticity, Seasonal variation, Flow rates, Rainfall infiltration.

The procedure of 'reference areas' to find out the most suitable drainage methods has shown that classical drainage methods are unsuitable for the heavy clay soil of the Sologne area, located 150 km south of Paris. Mole drainage seems appropriate for this soil because of the low permeability. The high clay content, structural stability and high plasticity should allow good durability of the moles. Soil was monitored using rainfall gauges, discharge recorders, gamma-neutronic probes and piezometers. The analysis of outflow coefficients, or restitution rates, shows two important points: (1) except during winter, when the outflow coefficient reaches almost 100% in February, it remains rather low because part of the rain serves to replenish the moisture deficit; and (2) the highest peak flow rates occur during rainfall of more than 23 mm/day. If the rainfall exceeds this value, surface runoff starts, causing at the same time a decrease of the outflow coefficient. (See also W87-05665) (Lantz-PTT)
W87-05690

SOIL VARIABILITY AND HYDRAULIC RESTRICTIONS IN THE MARSHLAND OF THE WEST CENTRAL ATLANTIC REGION OF FRANCE,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Cestas Principal (France). Div. Hydraulique Agricole.
P. Collas, L. Damour, and Y. Pons.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 178-184, 2 fig, 2 tab, 8 ref.

Descriptors: *Soil water, *Hydraulic properties, *Marshes, *France, *Drainage, Wetlands, Soil salinity, Soil management, Tillage, Crops.

The marshlands of the French west central Atlantic region cover an area of nearly 250,000 ha between the Villaine in the north and the Gironde in the south. The marsh soils are known as 'Bri and are usually clay soils (40 to 60% clay), often saline and sodic. The marshes are not everywhere drained to the same extent and even where the collective management of main drainage system is efficacious, it is not systematically extended to field drainage, although this is an essential requirement for any step toward more intensified agriculture. Defective water management, deficiencies in electrical energy availability, the unsuitability of farming structure and the difficulties of soil tillage, explain the prevalence of natural grassland and its extensive use (0,6 UGB/ha), which leads to poor economic results. Observations on drained plots revealed the extreme interdependence between soil type, drainage system, soil tillage and crop sequence. Different hydraulic performance of soils leads to a whole series of consequences, the most important of which are: (1) main drainage system; (2) field subsurface drainage (spacing, slope, collectors, construction); (3) soil evaluation after drainage; (4) tillage; (5) range of suitable crops; and (6) environment. Knowledge about the hydraulic performance and its effect, becomes of prime importance since it enables one to adjust the means and systems of production to the possibilities of the soil. (See also W87-05665) (Lantz-PTT)
W87-05691

SIMULATION OF THE HYDRAULIC BEHAVIOUR OF A PLOT OF DRAINED AND TILLED MARSHLAND,
J. Duprat.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 185-190, 2 fig.

Descriptors: *Simulation analysis, *Hydraulic properties, *Marshes, *Drainage, *Hydraulic models, *Soil water, Mathematical models, Soil management, Soil porosity, Tillage, Agriculture, Seasonal variation.

A model of the hydraulic functioning of a drained marshy soil was mathematical constructed by accurately following a pedological model which diagrammatically represents the soil profile and its variations in behavior owing to varying water contents throughout the year. The soil profile was split up into three layers referred to as A, E and U respectively. Layer A, which ranged from 0 to 50 cm in depth, was limited at the based by a compacted floor. Layer E (from 50 to 90 cm) was considered to be constant in volume so that the total porosity is fixed and the microporosity develops, on swelling, with loss of macroporosity. U, below 90 cm, with its lower limit fixed at 210 cm, was considered to be an ordinary reservoir in which no distinction is made between free and immobilized water. Input data were the daily rain and P.E.T. (Potential Evapotranspiration), to which were added temperatures during spells of frost. The operation of the hydraulic model required a certain number of parameters, such as the minimum and maximum volumes of the microporosity and the macroporosity for A and E, the porosity of the reservoir U, as well as parametric relationships. These were derived from measurements carried out for this purpose in the field and/or from model adjustment. By comparing the calendar of tillage possibilities and the farming calendar, conclusions can be drawn about the feasibility of different farming operations. (See also W87-05665) (Lantz-PTT)
W87-05692

HYDRAULIC AND HYDROLOGICAL OPERATING OF A FIELD EXPERIMENT IN LORRAINE HEAVY CLAY SOIL OVER A PERIOD OF EIGHT YEARS,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
B. Lesaffre, R. Morel, A. Kinjo, L. Florentin, and F. Jacquin.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 191-196, 3 fig, 2 tab, 13 ref.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Hydraulic properties, *Soil water, *Field tests, *Lorraine, *France, Clays, Statistical analysis, Rainfall, Flow rate, Discharge, Soil saturation, Soil swelling, Soil shrinking, Soil properties, Peak flow.

The statistical analysis of rainfall and flow rate discharge data over a period of eight years, in Lorraine, France, shows simultaneously the similarity of the drainage operating in any soil temporarily waterlogged, and the differences according to the soil type nature and constituents. The drainage outflow coefficient is higher in the pelosol than in the leached brown soil, because of its swelling and shrinking property and its position in the catena. The peak flows are higher in the pelosol, because of its low permeability and its slope. The amount of surface flow is therefore bigger, as is the yield of solutes, which is linked to the exchange complex. (See also W87-05665) (Lantz-PTT)
W87-05693

TRITIATED WATER MOVEMENT IN CLAY SOILS OF A SMALL CATCHMENT UNDER TROPICAL RAINFOREST IN NORTH-EAST QUEENSLAND,
James Cook Univ. of North Queensland, Townsville (Australia).
M. Bonell, D. S. Cassells, and D. A. Gilmour.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 197-201, 2 fig, 2 tab, 8 ref.

Descriptors: *Soil water movement, *Flow profile, *Flow rate, *Clays, *Queensland, *Australia, *Tritium, *Tracers, Tropical regions, Catchment areas, Radioactive tracers.

Tritiated water was used to trace soil water movement in kaolinitic clays below the active surface and subsurface stormflow layer, >0.2 m, at two contrasting sites in a tropical rainforest catchments in north-east Queensland. Mean annual rainfall is 4239 mm with a marked concentration (63.5%) in the summer months December to March. The deep (6 m) Ultisols-Inceptisols range from light to medium clay, with a fine to moderate blocky structure and the largely kaolinitic clay content in-

creases to a maximum of 51% at the 0.4-0.5 m depth. The experiment shows that both interstitial piston flow and preferential flow can occur simultaneously in these heterogeneous clays under low matric potentials. The effect of spatial variability of hydraulic properties has also been demonstrated. However, the long soil water transit times, especially below 1.0 m, have management implications. Large areas of former tropical rainforest have been cleared for sugar cane farming and high chemical inputs are required to maintain productivity levels to offset intense leaching of the surface layers by lateral stormflow. These results indicate the potential for accumulation of agricultural chemicals in the lower layers despite the high rainfalls. (See also W87-05665) (Lantz-PTT)
W87-05694

FACTORS CONDITIONING THE SURFACE WATERLOGGING OF LEACHED CLAY CHERNOZEMS IN BULGARIA,
M. Pencov, B. Djuninski, and T. Palaveev.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 202-204, 1 tab, 4 ref.

Descriptors: *Waterlogging, *Soil water, *Soil saturation, *Bulgaria, *Clay, Permeability, Soil porosity, Bulk density, Montmorillonite, Magnesium, Soil compaction.

Low water permeability in leached clay chernozems in Bulgaria,, is thought to be due to the following factors: (1) there is a high clay content which varies between 48% and 62%; and (2) in part of the soils, the percentage of exchangeable Mg is relatively high (20% to 40% of adsorbed cations). In addition, the following properties appear to play a role: (1) the water content at field capacity is high; (2) two horizons are compact with a bulk density of 1.4 gm to 1.5 gm/cu m at field water capacity and 1.9 gm/cu m in dry soil; and (3) the porosity is high. The negative influence of the agrotechnical activity of man has been evident by tillage with big agricultural machines, which is sometimes performed at high moisture contents. This leads to compaction of the soil, decrease in the humus content of the fallow land and soil structure degradation. Ploughing at a constant depth has caused the formation of slowly permeable plowpans. (See also W87-05665) (Lantz-PTT)
W87-05695

WATER AND SOLUTE MOVEMENT IN A HEAVY CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
D. E. Smiles, and W. J. Bond.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 205-219, 3 fig, 18 ref.

Descriptors: *Leaching, *Soil water, *Clays, *Soil water movement, *Solute transport, *Calcium chloride, *Path of pollutants, Flow profile, Unsaturated flow, Theoretical analysis, Chemical analysis, Mathematical studies, Research priorities.

Solute movement in soil is conventionally described in terms of diffusive forces that affect the distribution of the salt relative to the water, and convective effects due to soil water flow. A series of experiments was conducted that illustrate the application of these ideas to CaCl2 movement during non-steady, unsaturated water flow in sand, and in a structurally stable heavy clay soil. The results are discussed in terms of simple concepts in soil water theory, and surface physical chemistry. Some areas where further experimental and theoretical work is possible are: (a) mixed cation systems; (b) strongly structured soils; and (c) structurally unstable soils. (See also W87-05665) (Lantz-PTT)
W87-05696

ANALYSIS OF SOLUTE MOVEMENT IN STRUCTURED SOILS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W87-05697

SALT TRANSPORT IN HEAVY CLAY SOIL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 5B.
W87-05698

EFFECT OF ANION EXCLUSION ON SOLUTE TRANSPORT IN SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 5B.
W87-05699

EVALUATING A MODEL FOR NITRATE LEACHING IN CLAY SOILS WITH MACROPORES,
Oxford Univ. (England). Dept. of Agricultural Science.
For primary bibliographic entry see Field 5B.
W87-05700

SOILS AND SOLUTE PATTERNS IN RECLAIMED ESTUARINE MARSHLAND IN SOUTH-EAST ENGLAND,
Rothamsted Experimental Station, Harpenden (England).
P. J. Loveland, R. G. Sturdy, and J. Hazelden.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 252-257, 2 fig, 2 tab, 5 ref.

Descriptors: *Saline soils, *Leaching, *Floods, *Marshes, *England, *Solute tranport, *Path of pollutants, *Soil water, Land reclamation, Clays, Soil permeability, Sodium, Electrical conductivity, Organic carbon, Calcium carbonate, Land use, Soil properties, Wetlands.

The heavy clay soils of embanked marshes bordering the Thames Estuary in Kent were last flooded by the sea in 1953. Some land has been drained in the last 10-15 years to allow cereal production, but blocking of the pipe drains with dispersed clay, followed by structural collapse and crop failure is widespread. The soils are Typic Fluvaquents with a saline horizon (Electrical Conductivyt > 4 mmho/cm) within 1 m of the soil surface. Like the 'knip' or 'knick' soils of The Netherlands and North Germany, the subsoils have small pereability, large exchangeable sodium percentage and Ca:Mg < 3. This paper reports the preliminary findings of an investigation of relationships between soil chemical and physical properties (exchangeable sodium percentage, electrical conductivity, dispersion rates, organic carbon, calcium carbonates), microrelief and land use history. (See also W87-05665) (Lantz-PTT)
W87-05701

TRANSPORT OF SOLUTE IN HIGHLY STRUCTURED SOILS,
Laboratorium voor Grondmechanica, Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W87-05702

SOLUTE DISPLACEMENT THROUGH A RENDZINA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 5B.
W87-05703

SOME THEORETICAL ASPECTS OF THE INFLUENCE OF SOIL-ROOT CONTACT ON UPTAKE AND TRANSPORT OF NUTRIENTS AND WATER,
Institute for Soil Fertility, Haren (Netherlands).
P. de Willigen.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 268-275, 4 fig, 2 tab, 8 ref.

Descriptors: *Theoretical analysis, *Solute transport, *Soil water, *Roots, *Mathematical studies, Nutrients, Mathematical equations, Soil shrinkage, Mathematical analysis.

The importance of limited soil-root contact with respect to transport of soil water toward the plant root has been recognized for some time. The probability of limited soil-root contact is greater the heavier the soil. To investigate the consequences of limited soil-root contact for the uptake of water and nutrients, the situation whereby a gap develops at port of the soil-root interface due to shrinkage of the soil and/or the root, was studied via mathematical methods. The equations and their interpretation are presented; under the conditions chosen, the effect of soil-root contact is only slight compared with the effect it has on the availability of nutrients. (See also W87-05665) (Lantz-PTT)
W87-05704

IMPROVEMENT IN LEACHING EFFICIENCY OF A SILTY CLAY LOAM SOIL THROUGH APPLICATION OF SAND,
Central Soil Salinity Research Inst., Port Canning (India).
H. S. Sen, and A. K. Bandyopadhyay.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 276-278, 1 fig, 3 ref.

Descriptors: *Leaching, *Soil water, *Silt, *Clay, *Loam, *Sand, *Mathematical analysis, Desalinization, Permeability coefficient, Soil porosity, Mathematical equations.

Desalinization of heavy textured soils through leaching is limited by their low hydraulic conductivity. An attempt has been made to improve leaching efficiency by altering the pore size distribution at the surface through application of sand. Data acquired through the use of lysimeters with a silty clay-loam profile, with and without sand, was analyzed using mathematical methods. The results clearly show a favorable influence of the sand mixed with the top soil upon the leaching efficiency. (See also W87-05665) (Lantz-PTT)
W87-05705

MODELLING THE INTERACTION BETWEEN SOLUTE LEACHING AND INTRA-PED DIFFUSION IN CLAY SOILS,
Rothamsted Experimental Station, Harpenden (England).
T. M. Addiscott.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 279-297, 4 fig, 2 tab, 13 ref.

Descriptors: *Model studies, *Solute transport, *Leaching, *Soil water, *Clays, *Path of pollutants, Mathematical model, Mathematical analysis, Simulation analysis.

A simple model treats the soil profile in layers, each containing a mobile phase that can be displaced by rainfall and an immobile phase held in cubic peds, with inter-phase solute movement occurring by diffusion. This was tested against experimental analogues consisting of columns of chalk cubes and then used to simulate the effects of ped size and other variates on solute retention by clay soils undergoing leaching. The increase in solute retention due to the presence of an immobile phase is supplemented by retention arising from the fact that solute movement between the phases occurs by diffusion and never proceeds to equilibrium. The simulations showed this extra retention to become potentially more important as cumulative

rainfall and then potential leaching, increased. The extent to which this extra retention occurs depends on the size and diffusional impedance of the peds, but was also strongly influenced in the simulations by the pattern of rainfall. Whether the ped sizes were uniform or normally or log-normally distributed also affected this retention appreciably. Simulations that took account of anion exclusion showed that salts became more strongly retained as their concentrations declined. (Author's abstract)
W87-05706

USING SOIL MORPHOLOGY TO DEVELOP MEASUREMENT METHODS AND SIMULATION TECHNIQUES FOR WATER MOVEMENT IN HEAVY CLAY SOILS,
Stichting voor Bodemkartering, Wageningen (Netherlands).
J. Bouma.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 298-315, 4 fig, 19 ref.

Descriptors: *Soil water movement, *Soil water, *Soil morphology, *Simulation analysis, *Clay, Soil porosity, Computer models, Model studies, Pore size, Soil cracking, Gypsum.

Soil morphology data, in terms of number, size and length of large soil pores/unit surface area, are used to define: (1) optimal sample sizes for physical measurements and (2) computer simulation models for water movement in heavy clay soils. The simulation models use standard numerical procedures to predict vertical and horizontal fluxes, while morphology data provide boundary conditions for the flow system. The morphological techniques being used require not only a description but also application of staining and/or filling of large pores with gypsum. Examples are discussed for cracks (planar voids) and cylindrical worm-channels. Soil morphology provides data that cannot be obtained with physical methods. Hopwever, such data are only relevant for characterizing water movement when applied in a soil physical context. (See also W87-05665) (Author's abstract)
W87-05707

NMR MEASUREMENT OF WATER IN CLAY,
Soil Conservation Service, College Park, MD.
For primary bibliographic entry see Field 7B.
W87-05708

TIME RESPONSE CHARACTERISTICS OF TENSIOMETERS IN HEAVY CLAY SOILS,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 7B.
W87-05709

MOISTURE CHARACTERISTIC OF HEAVY CLAY SOILS,
Agricultural Univ., Wageningen (Netherlands).
L. Stroosnijder, and G. H. Bolt.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 324-329, 9 fig, 3 ref.

Descriptors: *Soil water, *Clays, *Soil pressure, Soil moisture meters, Tensiometers, Soil shrinking, Soil swelling, Soil load, Void ratio.

In dealing with problems of flow of water in unsaturated soils, there is need for a relationship between the volume fraction of water and an appropriate component of the water potential. In rigid soils, the relation between the matrix potential and the volume fraction of water, is named the moisture characteristic or rententivity curve of the soil. Studies of the moisture characteristics of soils indicate that there are four variables which describe shrinkage and drying of heavy clay soil: the moisture ratio, the pressure determined with a tensiometer, the load on the soil, and the void ratio. (See also W87-05665) (Lantz-PTT)
W87-05710

COMPUTER OPTIMIZATION OF A HEAVY SOIL DRAINAGE SYSTEM BY TWO-DIMENSIONAL SATURATED-UNSATURATED WATER FLOW MODELING,
Institute of Soil Science and Yield Prediction, Sofia (Bulgaria).
N. Shopsky, I. Nickolov, and E. Doneva.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 330-333, 2 tab, 9 ref.

Descriptors: *Soil water, *Soil water movement, *Drainage systems, *Computer models, *Flow profiles, *Bulgaria, Saturated flow, Unsaturated flow, Permeability coefficient, Mathematical models, Mathematical analysis, Tube drainage, Mole drainage, Hydraulic properties.

In Bulgaria, more than 10% of the area under cultivation is occupied by surface flooded soils. These areas have low permeabilities in the upper layer. For high and stable yields to be obtained, scientific and engineering problems have to be solved. The objective of the present investigation is the optimization of an amelioration system covering an area of 2,000 ha of surface flooded area with heavy clay soils, in the Mikhailovgrad district of North Bulgaria. In this optimization, a method of mathematical modelling of soil water transfer was used. It allowed a selection among all possible variations of the grid system to attain the best technical characteristics. Then the optimal variant was singled out combining good hydraulic characteristics with suitable economic indexes. Calculations were made for three types of drain grid systems: (1) tube drainage, (2) tube drainage combined with deep loosening at 60, 80, or 100 cm below the surface, and (3) mole drainage combined with relatively widely spaced tube drainage. The results of the study show that the best drainage system consists of drains at a depth of 1.3 m below the surface, with spacings of 25 m. Drains are placed in sand and gravel filters. The soil should be loosened every four years. Thus, a management system is obtained that optimizes hydraulic and economic aspects. (See also W87-05665) (Lantz-PTT)
W87-05711

USE OF THE NEUTRON PROBE AND TENSIOMETERS TO MONITOR GRAVITY IRRIGATION IN SOILS OF LOW PERMEABILITY,
Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France).
J. M. Allard, and O. Auriol.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 334-341, 4 fig, 5 ref, append.

Descriptors: *Soil water, *Neutron probe, *Tensiometers, *Irrigation, *Kirkuk, *Iraq, Permeability coefficient, Soil porosity, Irrigation practices.

Using a neutron probe, it has been possible to determine the behavior of a soil of low permeability under irrigation in the Kirkuk region of Iraq, and to assess its change during the irrigation seasons via regular in-situ soil humidity measurements. The conclusions that can be drawn from these experiments concern: the irrigation applications which, under present conditions, should be more frequent and of shorter duration because of the low soil permeability; working of the soil, subsoiling in particular, to a depth of 60 - 80 cm before planting crops in the fields, which improves water infiltration at depth; and the volumes of irrigation water to be provided in the future irrigation area which will have to be revised upward because of the low efficiency of field irrigation. (See also W87-05665) (Lantz-PTT)
W87-05712

ROLE OF STRUCTURE FOR THE COMPRESSIBILITY AND TRAFFICABILITY OF HEAVY CLAY SOILS,
Bayreuth Univ. (Germany, F.R.). Abt. Bodenphysik.
For primary bibliographic entry see Field 8D.
W87-05713

MEASUREMENT OF SOIL STRUCTURAL PARAMETERS BY IMAGE ANALYSIS,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 8D.
W87-05714

SOIL WATER HYDROLOGY: SIMULATION FOR WATER BALANCE COMPUTATIONS,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W87-05731

FIELD VALIDATION OF SOIL MOISTURE MODELS FOR WATER BALANCE ESTIMATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W87-05732

2H. Lakes

LONGITUDINAL-VERTICAL HYDRODYNAMICS AND TRANSPORT WITH CHEMICAL EQUILIBRIA FOR LAKE POWELL AND LAKE MEAD,
Edinger (J.E.) Associates, Inc., Wayne, PA.
For primary bibliographic entry see Field 5B.
W87-05184

LAKE BROKOPONDO: FILLING PHASE LIMNOLOGY OF A MAN-MADE LAKE IN THE HUMID TROPICS,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
J. Van der Heide.
Offsetdrukkerij Kanters B.V., Alblasserdam, The Netherlands. 1982. 428 p.

Descriptors: *Limnology, *Lake Brokopondo, *Suriname River, *Rain forests, *Plankton, *Thermal stratification, *Lakes, *Reservoirs, Chlorophyta, Bacillariaphyta, Euglenophyta, Gastroticha, Epiliminion, Dissolved Oxygen, Hypolimnion, Desmids, Chlorococcales, South America, Chemical analysis, Humid areas, Lake classification.

Lake Brokopondo was created by the damming of the Suriname River (Suriname, South America) in February 1964 for the production of hydro-electric energy. The limnological effects accompanying the creation of the the reservoir were studied by sampling plankton and abiotic parameters during the filling phase. The geomorphological and climatological setting is described and the physical and chemical observations analysed. Samples were taken of the temperature, electrical conductivity, Secchi disk visibility, dissolved oxygen content, and plankton composition. Five stations were monitored weekly, the whole lake was transected at greater intervals, and streams above and below the lake area were investigated incidentally. Immediately upon inundation of forest grounds, severe deoxygenation and fish mortality occurred. Euglenophyta and Gastrotricha were characteristic plankton components during this 'transitional' stage. When the water became stagnant, a lacustrine thermal stratification developed. The thickness of the epilimnion increased from 1964 to 1967, at a maximum depth of 38 m. The oxygen content of the epilimnion generally increased in the same period. It could reach the saturation point in 'summers' in superficial layers, below which a steep oxycline existed along with the thermocline. As there was no overturn, the hypolimnion remained anoxic all the time. The amount of electrolytes increased drastically in deep regions. Anoxic, highly reductive hypolimnion was released into the downstream part of the river when the power station started operating. Vertical exchange oc-

cured in the 'winter' periods, as indicated by a decrease in epilimnetic oxygen content, and a return of 'transitional' plankton. Climatological and hydrological data suggest that complete mixing should have occured in 'winters', but the restraining effect of the drowned forest probably inhibited this. The general long term phytoplankton succesion in the lake was from Euglenophyta via Chlorococcales to Desmids. Blooms developed often, but Cyanophyta remained scarce. Mucilaginous green algae were generally dominant. Primary productivity was high. Rotifera were well represented. The information available about the filling phase of this lake may be useful for the prediction of developments in planned reservoirs in the humid tropics. (Ram-PTT)
W87-05255

SEWAGE SLUDGE AS AN ACIDITY FILTER FOR GROUNDWATER-FED LAKES,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5G.
W87-05259

EPIPHYLLOUS ALGAL COLONIZATION OF ELODEA CANADENSIS MICHX.: COMMUNITY STRUCTURE AND DEVELOPMENT,
Bath Univ. (England). School of Biological Sciences.
D. M. Patterson, and S. J. L. Wright.
New Phytologist NEPHAV, Vol. 103, No. 4, p 809-819, August 1986. 6 fig, 2 tab, 17 ref.

Descriptors: *Algal growth, *Epiphytes, *Macrophytes, Electron microscopy, Colonization, Leaves, Plant growth.

The initiation and development of an epiphyllous algal community on the aquatic macrophyte Elodea canadensis Michx. were described using light and scanning electron microscopy. From initial discrete colonizing cells, a confluent matrix developed which included bacteria, algae, fungi, protozoa, mucilage and inorganic particles. The microtopography of the leaf affected the initial colonization and influenced the growth of certain species. The tips, bases and edges of the leaves were the first areas to become colonized. As the age of the leaves increased, the density of the epiphyllon increased and the structure of the community changed. On young leaves, the Chlorophyta represented 80% of the community standing crop while on pre-senescent leaves this proportion was reduced to 52%. The Bacillariophyta increased in proportional representation from 17% on young leaves to 47% on older leaves. (Author's abstract)
W87-05269

NITROGEN FIXATION IN AN OLIGOTROPHIC, SALINE DESERT LAKE: PYRAMID LAKE, NEVADA,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
A. J. Horne, and D. L. Galat.
Limnology and Oceanography LIOCAH, Vol. 30, No. 6, p 1229-1239, November 1985. 6 fig, 2 tab, 52 ref.

Descriptors: *Nitrogen fixation, *Cyanophyta, *Pyramid Lake, *Oligotrophic lakes, *Eutrophication, Nevada, Heterogeneity, Carbon dioxide, Plankton, Nitrogen compounds, Lakes, Algae, Salinity, Seasonal variation, Nitrogen.

High rates of nitrogen fixation by a short-lived but dense unialgal bloom of the planktonic blue-green Nodularia spumigena provided 99.5% of the alga's needs and 81% of Pyramid Lake's annual total combined nitrogen input in 1979. Bloom size, duration, and presumably N2 fixation vary from year to year, but in 1979 about 900 t of nitrogen were fixed in 2 months in this large deep lake. The annual rate of N2 fixation was about 2 g/sq m. Planktonic N2 fixation was not measured during high inflow years and may have been small relative to river input. Lakewide average heterocysts to vegetative cell (H/C) ratios followed seasonal trends in N2 fixation, but synoptic samples showed only a weak relation between H/C and N2 fixation. N2 fixation was induced by low epilimnetic levels of inorganic nitrogen and ended before lake overturn in the fall. High rates of N2 fixation were confined to the upper 5% of the epilimnetic volume and thus occurredonly in calm weather when Nodularia colonies floated to the lake surface. (Author's abstract)
W87-05304

HORIZONTAL HETEROGENEITY OF NITROGEN FIXATION IN LAKE VALENCIA, VENEZUELA,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
S. N. Levine, and W. M. Lewis.
Limnology and Oceanography LIOCAH, Vol. 30, No. 6, p 1240-1245, November 1985. 4 fig, 14 ref. NSF Grants DEB 78-05324 and 80-03883.

Descriptors: *Nitrogen fixation, *Lake Valencia, *Heterogeneity, Water sampling, ANOVA, Venezuela, Temporal distribution, Spatial distribution, Synoptic analysis, Cyanophyta, Volumetric analysis, Nitrogen, Aerobic conditions, Water analysis, Ephemeral lakes.

Spatial and temporal variability of nitrogen fixation in Lake Valencia, Venezuela, were quantified on the basis of duplicate water samples collected from a depth of 0.5 m at 16 sites on 10 dates. The concentration of heterocysts in samples was determined and the samples were incubated with acetylene in situ. Two-way ANOVA was used to separate the variance associated with site (fixed spatial patchiness), date (temporal variation), the interaction between site and date (ephemeral spatial patchiness), and sampling error. The nitrogen fixers in Lake Valencia are arranged in large (40-200 sq km), ephemeral patches with distinctive fixation rates per heterocyst. Both variability in fixation per heterocyst and variability in heterocyst concentration contribute significantly to variation in fixation per unit volume of lake water, but the variability attributable to heterocyst abundance is greater. Spatial variation in fixation, and heterocyst ariation in these parameters, and the ephemeral component of patchiness is much greater than the fixed component. (Author's abstract)
W87-05305

RECOLONIZATION OF MACROBENTHIC INVERTEBRATES IN A NIGERIAN STREAM AFTER PESTICIDE TREATMENT AND ASSOCIATED DISRUPTION,
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-05308

THERMALLY FORCED CIRCULATION IN A SMALL, ICE-COVERED LAKE,
Goeteborg Univ. (Sweden). Oceanografiska Institutionen.
L. Rahm.
Limnology and Oceanography LIOCAH, Vol. 30, No. 5, p 1122-1128, September 1985. 4 fig, 1 tab, 15 ref.

Descriptors: *Iced lakes, *Thermal stratification, *Mathematical models, *Model studies, *Limnology, *Circulation patterns, Lake sediments, Density, Water temperature, Lake morphology, Velocity, Thermal conductivity, Heat transfer, Field tests, Prediction, Lakes.

A simple, one-dimensional model of the stratification in a small, ice-covered lake showed that the heat flux from the sediments gives rise to a stable stratification and an organized circulation pattern. Data from a field study were compared with the predictions of the model. The good agreement found suggests that the buoyancy layer at the nonhorizontal boundaries is essential in modeling the thermal circulation in this type of lake. (Author's abstract)
W87-05311

ALGAL COMMUNITIES OF SPRINGS AND STREAMS IN THE MT. ST. HELENS REGION, WASHINGTON, U.S.A. FOLLOWING THE MAY 1980 ERUPTION,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
For primary bibliographic entry see Field 5C.
W87-05315

SEASONAL ANALYSIS OF VOLATILE ORGANIC BIOGENIC SUBSTANCES (VOBS) IN FRESHWATER PHYTOPLANKTON POPULATIONS DOMINATED BY DINOBRYON, MICROCYSTIS AND APHANIZOMENON,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
For primary bibliographic entry see Field 5A.
W87-05316

LOST LOONS OF THE NORTHERN LAKES,
For primary bibliographic entry see Field 5C.
W87-05337

SPATIAL DISTRIBUTION AND ECOLOGY OF ZOOCHLORELLAE-BEARING CILIATES IN A PRODUCTIVE POND,
Freshwater Biological Association, Ambleside (England).
U.-G. Berninger, B. J. Finlay, and H. M. Canter.
Journal of Protozoology JPROAR, Vol. 33, No. 4, p 557-563, November 1986. 10 fig, 51 ref.

Descriptors: *Spatial distribution, *Vertical distribution, *Ecology, *Ponds, *Protozoa, *Chlorophyta, *Symbiosis, *Population dynamics, *Zoochlorellae, Distribution, Oxygen, Carbon dioxide, Temperature, Nitrogen, Respiration, Aquatic life, Aquatic environment, Environment.

The spatial distribution of five zoochlorellae-bearing ciliate species (Euplotes daidaleos, Frontonia vernalis, Acaryophyra sp., Disematostoma butschlii, and Stokesia vernalis) were investigated in a productive freshwater pond. The vertical profiles of all species were compared to the levels of O2, CO2, light, temperature, dissolved inorganic nitrogen, and the availability of particulate food sources. In the stratified water column, Stokesia remained close to the water surface: all other species reached peak abundance close to the oxic-anoxic boundary. The latter behavior probably accommodated the ciliates' requirements for aerobic respiration and particulate food and their dependance on light and dissolved nutrients, which come from opposite directions. With the collapse of stratification, Euplotes and Frontonia returned to the sediment where they reverted to a heterotrophic nutrition while retaining some zoochlorellae. Acaryophyra and Disematostoma also became heterotrophic, but they remained evenly distributed in the water column and they lost their zoochlorellae. Stokesia disappeared, presumably because it encysted. There was some evidence for vertical spatial separation of the five species in the water column. (Author's abstract)
W87-05348

GROWTH OF THERMOPHILIC OBLIGATELY AUTOTROPHIC HYDROGEN-OXIDIZING BACTERIA ON THIOSULFATE,
Iceland Univ., Reykjavik. Biological Inst.
G. A. Alfredsson, A. Ingason, and J. K. Kristjansson.
Letters in Applied Microbiology, Vol. 2, No. 2, p 21-23, 1986. 1 fig, 12 ref.

Descriptors: *Water pollution effects, *Growth rate, *Hot springs, *Bacterial physiology, *Bacterial growth, *Culturing techniques, *Growth media, *Microbiological studies, *Thiosulfate, Culture media, Springs, Sulfur, Oxidation, Agars, Iceland.

Ten strains of thermophilic obligately autotrophic H2-oxidizing bacteria from Icelandic hot springs were tested for growth on thiosulfate. All grew on thiosulfate but not on sulfite or sulfur. The product of thiosulfate oxidation was sulfate. The growth rate on thiosulfate was slower than on H2. Washed cells which had been grown on thiosulfate could

oxidize thiosulfate rapidly, but H2-grown cells oxidized thiosulfate much more slowly and with about a three-hour lag time. The bacteria would not grow on agar medium under H2 but grew on agar medium containing thiosulfate. The previous inability of H2-oxidizing bacteria to grow on solid media has been a drawback to research. The present results make further work on these bacteria easier and are a prerequisite for genetic work. (Author's abstract)
W87-05350

ASSEMBLAGE ORGANIZATION OF STREAM FISHES: THE EFFECT OF RIVERS ON ADVENTITIOUS STREAMS,
Northern Illinois Univ., De Kalb. Dept. of Biological Sciences.
O. T. Gorman.
The American Naturalist AMNTA4, Vol. 128, No. 4, p 611-616, October 1986. 27 ref.

Descriptors: *Adventitious streams, *Aquatic habitats, *Ecosystems, *Rivers, *River systems, *Fish populations, Fish, Ecology, Habitats, Aquatic habitats, Dams, Distribution, Seasonal distribution, Populations.

The validity of a 1982 study by Grossman et al. on the stochastic organization of an Indiana stream fish assemblage is questioned because of unrecognized methodological problems. The stream chosen for study, Otter Creek, is a third-order adventitious stream of the sixth- or seventh-order Wabash River. The effects on community and ecosystem properties of the discontinuity between tributary and main stream are discussed, and it is concluded that, while Grossman's results are probably typical of an adventitious stream, they cannot be generalized and applied to other streams. Attributes of assemblage structure in stream fishes are affected by environmental variability, habitat structure, age of the individual, ecological differences among species groups, and drainage position in relation to the master stream. Recognition of adventitious streams in future research may help clarify attributes of stream fish assemblages and thereby contribute to the development of stream-ecosystem theory. (Doria-PTT)
W87-05354

FACTORS AFFECTING HIGH-OXYGEN SURVIVAL OF HETEROTROPHIC MICROORGANISMS FROM AN ANTARCTIC LAKE,
Tennessee Univ., Knoxville. Inst. for Applied Microbiology.
A. T. Mikell, B. C. Parker, and E. M. Gregory.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1236-1241, December 1986. 2 fig, 3 tab, 31 ref.

Descriptors: *Heterotrophic bacteria, *Lake Hoare, *Bacterial growth, *Dissolved oxygen, *Water pollution effects, *Survival, Plankton, Oxygen, Nutrients, Enzymes, Oligotrophic lakes, Culture media.

Intra- and extracellular reactions involving oxygen can create by-products more reactive and hazardous to cells than molecular oxygen. These include superoxide, hydrogen peroxide, singlet oxygen, and the hydroxyl radical. The factors relating to the survival of heterotrophic microorganisms from the high-dissolved-oxygen (HDO) waters of Lake Hoare, Antarctica were determined. This lake contains perpetual HDO about three times that of normal saturation (40 to 50 mg/liter). Five isolates, one yeast and four bacteria, were selected from Lake Hoare waters by growth with the membrane filter technique with oxygen added to yield dissolved concentrations 14 times that in situ, 175 mg/liter. One bacterial isolate was obtained from the microbial mat beneath the HDO waters. This organism was isolated at normal atmospheric oxygen saturation. The bacteria were gram-negative rods, motile, oxidase positive, catalase positive, and superoxide dismutase positive; they contained carotenoids. The planktonic isolates grew in media containing 10 mg of Trypticase soy (BBL Microbiology Systems)-peptone (2:1)/liter but not at 10 g/liter. Under low-nutrient levels simulating Lake Hoare waters (10 mg/liter), two of the planktonic isolates tested were not inhibited by HDO. Growth inhibition by HDO increased as nutrient concentration was increased. A carotenoid-negative mutant of one isolate demonstrated a decreased growth rate, maximal cell density, and increased cell lysis in the death phase under HDO compared with the parent strain. The specific activity of superoxide dismutase was increased by HDO in four of the five bacterial isolates. The superoxide dismutase was of the manganese type on the basis of inhibition and electrophoretic studies. The bacterial isolates from Lake Hoare possess several adaptations which may aid their survival in the HDO waters, as well as protection due to the oligotrophic nature of the lake. (Alexander-PTT)
W87-05393

PRODUCTION AND TURNOVER OF PLANKTONIC BACTERIA IN TWO SOUTHEASTERN BLACKWATER RIVERS,
Georgia Univ., Athens. Inst. of Ecology.
R. T. Edwards, and J. L. Meyer.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1317-1323, December 1986. 1 fig, 5 tab, 40 ref. NSF Grants DEB-8104427 and BSR-8406631.

Descriptors: *Productivity, *Turnover, *Planktonic bacteria, *Blackwater rivers, *Isotope studies, *Bacterial metabolism, *Biomass, Seasonal variation, Bacterial growth, Temperature, Prediction, DNA, Rivers, Bacteria, United States.

Production by attached and free-living planktonic bacteria in two blackwater rivers in the Southeastern United States was measured over a period of 14 months by using the rate of incorporation of (methyl-3H)thymidine into DNA. Production rates and biomass dynamics were compared to determine the potential for in situ production to supply planktonic biomass. Bacterial production in these rivers was moderate and varied seasonally. Rates varied from 0.058 to 2.120 mg of C/cu m/h in the Ogeechee River and from 0.002 to 2.418 mg of C/cu m/h in Black Creek. Regressions of growth rate on various environmental variables showed that temperature and total dissolved organic carbon concentration were the best predictors of growth. Although attached bacteria were < 21% of the total biomass, they accounted for up to 53% of the total production. Turnover times for attached bacteria ranged from < 1 day to > 3 years depending on season. Turnover times of free-living bacteria varied from 4.4 days to 11.8 years. Comparisons of biomass with production indicated that during most seasons, the majority of bacterial biomass in these rivers was of allochthonous origin. During summer, when water temperatures were high, bacterial growth in the river may have supplied a greater percentage of the standing stock of bacteria than allochthonous inputs. (Author's abstract)
W87-05397

SPATIAL AND TEMPORAL VARIATIONS IN BACTERIAL MACROMOLECULE LABELING WITH (METHYL-3H)THYMIDINE IN A HYPERTROPHIC LAKE,
National Inst. for Water Research, Pretoria (South Africa).
R. D. Robarts, R. J. Wicks, and L. M. Sephton.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1368-1373, December 1986. 1 fig, 5 tab, 23 ref.

Descriptors: *Hypertrophic lakes, *Isotope studies, *Bacterial metabolism, *Bioaccumulation, *Spatial variation, *Temporal variation, DNA, RNA, Proteins, Productivity, Enzymes, Lipids, Phytoplankton, Bacteria, South Africa.

The incorporation of (methyl-3H)thymidine into DNA as a measure of aquatic bacterial production is being widely used in marine and freshwater microbial ecology studies. The imprecision of converting thymidine incorporation rates into bacterial production rates is a major weakness of the method. Many aspects of this problem have been examined. One aspect, the possible lack of macromolecular specificity by thymidine labeling, has received some attention, but conclusions in the literature remain uncertain. The incorporation of (methyl-3H)thymidine into three macromolecular fractions, designed as DNA, RNA, and protein, by bacteria from Hartbeespoort Dam, South Africa, was measured over 1 year by acid-base hydrolysis procedures. Samples were collected at 10 m, which was at least 5 m beneath the euphotic zone. On four occasions, samples were concurrently collected at the surface. Approximately 80% of the label was incorporated into bacterial DNA in surface samples. At 10 m, total incorporation of label into bacterial macromolecules was correlated to bacterial utilization of glucose ($r = 0.913$, $n = 13$, $P < 0.001$). The labeling of DNA, which ranged between 0 and 78% of total macromolecule incorporation, was inversely related to glucose uptake ($r = -0.823$), total thymidine incorporation ($r = -0.737$), and euphotic zone algal production ($r = -0.732$, $n = 13$, $P < 0.005$). With decreased DNA labeling, increasing proportions of label were found in the RNA fraction and proteins. Enzymatic digestion followed by chromatographic separation of macromolecule fragments indicated that DNA and proteins were labeled while RNA was not. The RNA fraction may represent labeled lipids or other macromolecules or both. The data demonstrated a close coupling between phytoplankton production and heterotrophic bacterial activity in this hypertorphic lake but also confirmed the need for the routine extraction and purification of DNA during (methyl-3H)thymidine studies of aquatic bacterial production. (Alexander-PTT)
W87-05401

EFFECTS OF LONG-TERM EXPOSURE TO PENTACHLOROPHENOL ON THE FREE AMINO ACID POOL AND ENERGY RESERVES OF THE FRESHWATER AMPHIPOD GAMMARUS PSEUDOLIMNAEUS BOUSFIELD (CRUSTACEA, AMPHIPODA),
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W87-05412

FLUORESCENCE INDUCTION AND PHOTOSYNTHETIC RESPONSES OF ARCTIC ICE ALGAE TO SAMPLE TREATMENT AND SALINITY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
S. S. Bates, and G. F. Cota.
Journal of Phycology JPYLAJ, Vol. 22, No. 4, p 421-429, December 1986. 10 fig, 46 ref.

Descriptors: *Temperature effects, *Ecology, *Photosynthesis, *Ice algae, *Fluorescence induction, *Sample preparation, *Algae, *Salinity, *Arctic, Bottom ice, Algal physiology, Seawater, Chlorophyll a, Ice.

The measurement of photosynthetic rates of algae growing on the undersurface of 1.7 m thick ice in the Canadian Arctic (Resolute Passage, N. W. T.) presents several problems. During the preparation of samples for physiological measurements, the ice algae may be exposed to salinity and temperature shocks. Fluorescence induction (the rise in in vivo Chl a fluorescence intensity during a period of milliseconds) and photosynthesis-irradiance (PI) experiments examined the potential effects of salinity and temperature on the physiology of ice algae. Experimental suspensions were routinely prepared by scraping one part ice crystals (1.1-1.4% salinity) and attached algae from the bottom ice into four parts filtered seawater (3.2% salinity), giving a final salinity of 2.8-3.1%. Post-dilution of melted ice scrapings with seawater suppressed photosynthetic 14C-fixation and decreased A sub DCMU (the area above the fluorescence induction curve measured in the presence of the inhibitor DCMU; an estimate of photosynthetic capacity) by a factor of 3-16, due to the low salinity of the melted ice scrapings. Fluorescence induction and PI experiments showed that the ice algae had a salinity optimum near 3.0%, close to the ambient seawater salinity. Experiments in which the Chl a concentration was manipulated showed that A sub DCMU, Chl a-normalized rate of photosynthesis at light saturation, and alpha (photosynthetic efficien-

cy) declined with increasing Chl a concentration. Ice algae tolerated heating (1.5 C/min) up to 17 C, above which A sub DCMU decreased with sample temperature. (Author's abstract)
W87-05477

PHYCOBILIPROTEIN COMPOSITION AND CHLOROPLAST STRUCTURE IN THE FRESHWATER RED ALGA COMPSOPOGON COERULEUS (RHODOPHYTA),
Smithsonian Environmental Research Center, Rockville, MD.
E. Gantt, J. Scott, and C. Lipahultz.
Journal of Phycology JPYLAJ, Vol. 22, No. 4, p 480-484, December 1986. 6 fig, 11 ref. DOE Contract AS05-76-ER-04310; NSF Grant BSR 83-07714.

Descriptors: *Algae, *Red algae, *Freshwater algae, *Chloroplasts, *Phycobiliproteins, *Phycobilisomes, Axial cells, Cell extracts, Ultrastructure, Microscopy, Compsopogon.

The chloroplast structure and phycobiliprotein composition of relatively few freshwater red algae have been studied. Here we report on Compsopogon coeruleus (Rhodophyta, Compsopogonaceae), which is thought to have one of the most complex thallus developments of all bangiophycean algae. Serial sections of uncorticated axial cells of Compsopogon coeruleus revealed a single interconnected parietal chloroplast. Phycobilisomes in such chloroplasts were hemidiscoidal in shape with a broad-face diameter of ca. 25-30 nm. The molar ratio of phycobiliproteins in whole cell extracts was 1PE:3PC:1APC, similar to isolated phycobilisomes. Two spectrally distinct C-phycocyanin forms (A618 nm, F648 nm and A630 nm, F652 nm) were resolved in dissociated phycobilisomes along with B-phycoerythrin and allophycocyanin. (Alexander-PTT)
W87-05478

31P-NMR STUDIES ON INORGANIC POLYPHOSPHATES IN MICROALGAE,
Tokyo Univ. (Japan). Inst. of Applied Microbiology.
T. Oh-hama, F. Siebelt, K. Furihata, H. Seto, and S. Miyachi.
Journal of Phycology JPYLAJ, Vol. 22, No. 4, p 485-490, December 1986. 4 fig, 1 tab, 35 ref.

Descriptors: *Nuclear magnetic resonance, *Inorganic polyphosphates, *Microalgae, *Phosphorus metabolism, *Algal metabolism, *Algae, Hydrolysis, *Sample preparation, Spectral analysis.

Inorganic polyphosphates (polyP), linear polymers in which orthophosphate residues are linked by phosphate-anhydride bonds, are normal constituents of microorganisms. PolyP have been widely investigated in prokaryotic and eukaryotic algae. Usually these compounds are identified in living organisms by cytochemical as well as classical chemical methods such as the determination of acid-labile phosphate . Using 31P nuclear magnetic resonance analysis, total inorganic polyphosphate in algae could be quantitatively estimated. For this purpose the algal suspension, which had been kept in cold trichloroacetic acid, was further treated with 6 mM EDTA, or the cells were kept in 2 N KOH containing 100 mM EDTA for 18 h at 37 C. These simple methods avoid hydrolysis of cellular inorganic polyphosphate and, therefore, are useful for the study of phosphorus metabolism in algae. The effects of these treatments on visualization of the signal for inorganic polyphosphate in nuclear magnetic resonance spectra were discussed in comparison with in vivo 31P nuclear magnetic resonance spectra of algae. (Alexander-PTT)
W87-05479

LIPIDS IN BLUE-GREEN ALGAL MATS (MODERN STROMATOLITES) FROM ANTARCTIC OASIS LAKES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Plant Pathology and Physiology.
D. M. Orcutt, B. C. Parker, and W. R. Lusby.
Journal of Phycology JPYLAJ, Vol. 22, No. 4, p 523-530, December 1986. 2 fig, 7 tab, 37 ref. NSF Grant DPP-80-12988.

Descriptors: *Lipids, *Cyanophyta, *Algal mats, *Stromatolites, *Antarctic lakes, *Antarctic, *Algae, Diatoms, Stenols, Lakes, Fatty acids.

The Antarctic Continent's largest frigid desert oasis is southern Victorialand (> 5000 sq km) and contains a number of unusual perennially ice-covered lakes, several of which have been recent focuses of fairly extensive investigations. Among the findings of interest from these studies have been the discovery of great biomasses of benthic blue-green algal-(diatomaceous)-microbial mats in at least seven oasis lakes, some of which are forming modern stromatolites. Lipids comprising the stenols, stanols, polar lipid fatty acids, alkanes and alkenes of blue-green algal-(diatomaceous)-microbial mats and cores (modern cold water stromatolites) collected from three Antarctic lakes were identified and compared with those of other algae. The major stenols were: (cholesta-5,22-dien-3-Beta-ol, cholest-5-en-3-Beta-ol, 24-methylcholesta-5,22-dien-3-Beta-ol, 24-methylcholest-5-en-3-Beta-ol, 24-ethylcholesta-5,22-dien-3-Beta-ol, and 24-ethylcholest-5-en-3-Beta-ol). The presence of C28 Delta 5,22 stenols, as well as other C28 stenols, was suggestive of diatom input. C29 stenols may have originated from blue-green algae. However, the high concentrations of stenols present and the lack of Delta 7 stenols was atypical for known stenol components of several blue-green algal species previously reported. The occurrence of these stenols and other lipid markers strongly implicate diatoms as well as blue-green algae as important biogenetic sources of lipids and has established the potential for studies of lipid diagenesis in these unique cold, freshwater stromatolites. (Alexander-PTT)
W87-05480

OCCURRENCE AND STRUCTURE OF FLAGELLAR SCALES IN SOME FRESHWATER CRYPTOPHYTES,
Colorado State Univ., Fort Collins. Dept. of Anatomy.
R. E. Lee, and P. Kugrens.
Journal of Phycology JPYLAJ, Vol. 22, No. 4, p 549-552, December 1986. 9 fig, 4 ref.

Descriptors: *Flagellar scales, *Cryptophytes, *Algae, Taxonomy.

Among the Cryptophyceae, flagellar scales have been reported in Hemiselmis brunnescens, H. virescens and in Chroomonas sp. Flagellar scales are often important taxonomic indicators. Since the above three species represent a small proportion of the species in the Cryptophyceae, it was decided to examine a number of cryptophytes for the occurrence of flagellar scales. Flagellar scales were found in seven out of eleven freshwater cryptophytes investigated by shadowing whole cells. All scales examined were 140 to 170 nm in diameter and had a basic seven-sided rosette pattern with delicate interlacing. The results of this study indicate that flagellar scales are common in cryptophytes. (Alexander-PTT)
W87-05481

STRONG PROBABILITY OF LETHAL TOXICITY IN THE BLUE-GREEN ALGA MICROCYSTIS VIRIDIS LEMMERMANN,
Tokyo Metropolitan Research Lab. of Public Health (Japan).
For primary bibliographic entry see Field 5C.
W87-05482

EFFECT OF TREE CANOPY REMOVAL BY GYPSY MOTH LARVAE ON THE MACROALGAE OF A RHODE ISLAND HEADWATER STREAM,
Rhode Island Univ., Kingston. Dept. of Botany.
R. G. Sheath, J. M. Burkholder, M. O. Morison, A. D. Steinman, and K. L. VanAlstyne.
Journal of Phycology JPYLAJ, Vol. 22, No. 4, p 567-570, December 1986. 4 fig, 17 ref.

Descriptors: *Algae, *Canopy removal, *Gypsy moth larvae, *Macroalgal growth, *Headwater streams, *Light intensity, *Species density, *Productivity, Streams, Diatoms, Desmids, Defoliation, Macroalgae, Algae, Water temperature, Taxonomy.

A spring-fed, headwater stream in central Rhode Island was examined during the period from June to October, 1979 to 1982. In the first two summers, a dense riparian canopy reduced the light penetration at the stream surface to a range of 5 to 18% of incident radiation. The lotic macroalgal community during this period was limited to 1 to 4 species covering < 1 to 35% of the stream bottom. However, in June and July, 1981, the surrounding leaf canopy was removed by a massive gypsy moth larval outbreak. Light penetration to the stream during this summer increased to 73% by early July, thereby resulting in a rise in water temperatures by 3.7 C. Even though there was a partial regrowth of leaves in late July and August of 1981, macroalgal cover values continued to rise to an early August peak of 80%. During the third summer, 88% of the macroalgal abundance could be attributed to illumination and water temperature. The filamentous diatom Eunotia pectinalis (O.F. Mull.) Rabh. was the predominant species in the midsummer of all four years, accounting for at least 60% of the total cover. In 1981, an important taxon was the desmid Hyalotheca dissiliens (S. Smith) Breb., a species which was not seen in other years. A less severe gypsy moth defoliation occurred in 1982 but did not produce significant differences in light, temperature or macroalgal cover from 1979 and 1980. The results indicate that light and temperature can be limiting during the summer in spring-fed, headwater streams and that seed populations of some species are present in undetectable levels during these periods of suboptimal growth conditions. In addition, it appears that stream macroalgal communities can be quite resilient, recovering rapidly following a major perturbation. (Author's abstract)
W87-05483

RELEASE OF REDUCING SUGARS AND DISSOLVED ORGANIC CARBON FROM SPARTINA ALTERNIFLORA LOISEL IN A GEORGIA SALT MARSH,
Georgia Univ., Athens. Inst. of Ecology.
J. D. Pakulski.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 385-394, April 1986. 4 fig, 32 ref.

Descriptors: *Monosaccharides, *Sugars, *Leachates, *Salt marshes, *Dissolved organic carbon, *Spartina, Georgia, Estuaries, Seasonal variation, Salinity, Accumulation, Tides, Aquatic plants, Plant physiology.

The production and consumption of dissolved organic matter (DOM) has been proposed as a significant component of marine ecosystems. Many studies have focused on the role of DOM in pelagic systems and littoral communities dominated by macrophyte algae. Eight monosaccharides were found to be released from both tall and short forms of Spartina alterniflora during tidal submergence including: 2-d ribose, rhamnose, ribose, mannose, arabinose, fructose, galactose and xylose. Glucose was not detected in the leachate of either growth form. Two additional monosaccharides were found but were not identified. Losses of total reducing sugars (TRS) and total dissolved organic carbon (TDOC) ranged from 14-54 microgram(ug) C/g dry wt/h and 42 to 850 ug C/g dry wt/h, respectively. Losses of individual monosaccharides were generally < 5 ug C/g dry wt/h and varied from 0.5-17 ug C/g dry wt/h. Differences were observed in seasonal patterns of losses between tall and short Spartina. Tall Spartina TRS losses peaked in midsummer, while in short Spartina TRS losses peaked in the spring and fall. TDOC losses in both tall and short Spartina followed similar patterns with peak losses occurring in the spring and fall. Periods of net uptake of TDOC were observed in both growth forms in midsummer. Uptake rates varied from 142-930 ug C/g dry wt/h. Estimated annual losses of TDOC from tall and short Spartina were between 100-150 and 5-10 g C/sq m/year, respectively. The magnitude and seasonal pattern of TDOC losses reported here

support Turner's conclusions that losses of labile DOM from Spartina are substantial in Georgia salt marshes and related to seasonal patterns of estuarine metabolism. (Alexander-PTT)
W87-05484

ACID PRECIPITATION EFFECT ON ANION TRANSPORT OF THE ATKINS RESERVOIR, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-05504

FORAGING RESPONSES OF STILTS (HIMANTOPUS SPP.; AVES) TO CHANGES IN BEHAVIOUR AND ABUNDANCE OF THEIR RIVERBED PREY,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
R. J. Pierce.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 17-28, 1986. 11 fig, 1 tab, 31 ref.

Descriptors: *Predation, *Stilts, *Water fowl, *Riverbeds, *Food habits, *Diets, *Aquatic insects, Cass River Valley, New Zealand, Riffles, Pools, Drift, Larvae, Water temperature, Habitats.

Riverbed foraging by pied stilts (Himantopus h. leucocephalus) and the endangered black stilt (H. novaezealandiae) was studied in the Cass River Valley, South Island, New Zealand. The staple riverbed diet of both species was aquatic larvae of Deleatidium spp. (Ephemeroptera), usually captured by pecking. When the larvae were inactive and hidden from view, particularly when the water temperature was below 5 C, black stilts used the non-visual methods of probing or raking in the gravel to find food. Pied stilts did not use non-visual methods and so were forced to feed at a low rate or move to other temporarily more profitable habitats. Black stilts foraged mainly at the riffles where prey was most abundant, whereas pied stilts foraged mainly at pools where prey was less common but more easily seen. During the emergence drift of Deleatidium, both species of stilts switched from feeding on larvae to feeding on drifting subimagines. (Author's abstract)
W87-05512

PREY SELECTION BY TORRENTFISH, CHEIMARRICHTHYS FOSTERI HAAST, IN THE ASHLEY RIVER, NORTH CANTERBURY, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
G. J. Scrimgeour.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 29-35, 1986. 4 fig, 4 tab, 24 ref.

Descriptors: *Predation, *Food habits, *Torrentfish, *Diets, *Aquatic insects, *Larvae, Ashley River, New Zealand, Fish, Invertebrates, Benthos.

The diets of two size classes of torrentfish (Cheimarrichthys fosteri Haast), taken from the Ashley River, North Canterbury, over two days in February-March 1984, were examined. Small fish (fork length 51-64 mm) fed mainly on larval Elmidae (Hydora sp.) and Chironomidae, whereas the diets of larger (71-109 mm) fish were dominated by Elmidae and Ephemeroptera (Deleatidium sp.) larvae. Aquatic larvae dominated diets of all fish; only one item of terrestrial origin was recorded. Torrentfish consumed proportionally greater numbers of slow than fast moving prey. The size range of most prey species taken was narrower than the range present in the river. Increasing fish length did not result in an increased variety of prey items consumed by C. fosteri. (Author's abstract)
W87-05513

EFFECTS OF FLOODS ON THE INVERTEBRATE FAUNA OF A LARGE, UNSTABLE BRAIDED RIVER,
Ministry of Agriculture and Fisheries, Wellington (New Zealand). Fisheries Research Div.
For primary bibliographic entry see Field 2E.
W87-05514

DISTRIBUTION AND PRODUCTION OF CHIRONOMUS IN EUTROPHIC LAKE NGAPOURI,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
D. J. Forsyth.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 47-54, 1986. 4 fig, 1 tab, 21 ref.

Descriptors: *Population dynamics, *Eutrophic lakes, *Productivity, *Midges, *Chironomus, *Biomass, Profundal zone, Littoral zone, Dissolved oxygen, Seasonal variation, Larvae, Migration, Sediments, Lake Ngapouri, Aquatic fauna, New Zealand.

The fauna of Lake Ngapouri, North Island, New Zealand, was dominated by two chironomid species-Chironomus zealandicus in the profundal zone and Chironomus sp. a in the littoral zone. Their distribution and production was most influenced by seasonal changes in water temperature and dissolved oxygen concentration. C. zealandicus was more tolerant of low oxygen conditions, hence its dominance in deeper water. C. zealandicus produced three generations and Chironomus sp. a two generations annually. Annual production of C. zealandicus (120.7 g DW/sq m) was 4 times that of Chironomus sp. a (30.7 g DW/sq m) but production:biomass ratios of the two species were similar and comparable with those obtained from most other studies of Chironomus. (Author's abstract)
W87-05515

HORIZONTAL AND VERTICAL VARIABILITY IN THE DISTRIBUTION OF AQUATIC MACROPHYTES IN LAKE WAIKAREMOANA,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
C. Howard-Williams, J. Davies, and W. F. Vincent.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 55-65, 1986. 5 fig, 4 tab, 33 ref, append.

Descriptors: *Species composition, *Aquatic plants, *Macrophytes, *Lake morphometry, *Spatial variation, Littoral zone, Zonation, Lake Waikaremoana, New Zealand, Vegetation, Lakes, Winds.

Lake Waikaremoana, North Island, New Zealand, with a surface area of 51 sq km, has a shoreline of 93 km. The complex lake morphometry means that most of the shoreline is sheltered from strong winds which leads to dense macrophyte development in the littoral zone. The distribution and abundance of the macrophytes around the lake were studied by a number of methods including horizontal and vertical SCUBA transects. Almost the entire shoreline is colonized to a depth of 16 m by macrophyte vegetation. Tall vascular aquatics occur to a depth of 8 m but the monospecific adventive communities found in many other North Island lakes are not found. The deep water macrophytes (8-16 m) are exclusively characeans with Chara corallina forming the deepest zone. Horizontal species composition and abundance were very uniform, an unusual situation when compared with other New Zealand lakes. Analysis of variance at different scales of horizontal distance showed that most of the variation in species performance was between individual quadrats 4 m apart rather than at longer distances. (Author's abstract)
W87-05516

LATE HOLOCENE DIATOMS IN LAKE POUKAWA: EFFECTS OF AIRFALL TEPHRA AND CHANGES IN DEPTH,
Victoria Univ., Wellington (New Zealand). Research School of Earth Sciences.
M. A. Harper, R. Howorth, and M. Mcleod.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 107-118, 1986. 6 fig, 30 ref, append.

Descriptors: *Tephra deposition, *Diatoms, *Hardwater lakes, *Sediment cores, *Lake morphology, *Volcanic ash, Alkalinity, Nutrients, Erosion, Lakes, Sediments, Deposition, Lake Poukawa, New Zealand.

Lake Poukawa, a shallow hardwater lake, is situated on calcareous lake silt overlying peat and alluvium. Two tephra layers, Taupo Pumice and Waimihia Lapilli, aged c. 2000 and 3500 calendar years respectively, were present in four cores (c. 6 m long) of the lake sediment. The diatom flora of the cores was studied to find any indication of changes in the lake morphology and to assess the effects of tephra deposition. Increased abundance of small Fragilaria spp. appears to indicate periods when the lake was less extensive, c. 3700-3500 y ago, and c. 2800-3000 y ago. In the recent past, increased abundance of Fragilaria spp. in lake sediment near the present southern margin almost certainly coincides with artificial draining since A. D. 1931. The occurrence of marine sponge spicules in the cores probably indicates that rates of erosion in the catchment were low before 2500 y ago and high 100-0 y ago. Diatom samples taken at close intervals adjacent to the Taupo and Waimihia tephras indicate that above the ash estimated numbers of diatoms per unit dry weight increase, but the proportion of epiphytic species decreases. Some of the possible causes of this increase are discussed. The tephra layers possibly preserved more diatom frustules, or increased diatom growth by supplying silica, phosphorus, and sulphur nutrients directly, or organic matter from vegetation damage in the surrounding catchment. Alternatively, in shallow hardwater lakes, if acids are deposited with the tephra and its fine particles form an impermeable layer on the calcite sediments the lake will become less alkaline and nutrient depleted. (Author's abstract)
W87-05518

CONCENTRATED BRINES AS HABITATS FOR MICROORGANISMS,
Bonn Univ. (Germany, F.R.). Inst. fuer Mikrobiologie.
H. G. Truper, and E. A. Galinski.
Experientia EXPEAM, Vol. 42, No. 11/12, p 1182-1187, December 1986. 2 fig, 2 tab, 68 ref.

Descriptors: *Brines, *Saline lakes, *Saline water, *Bacterial physiology, *Halophilic bacteria, Coastal lagoons, Soda lakes, Adaptation, Aquatic habitats, Compatible solutes.

Concentrated salt solutions (brines) occur widely naturally in coastal lagoons and salt or soda lakes and in man-made form in salterns or saltworks. They are inhabited by a limited number of specialized microorganisms, which use different strategies of haloadaptation. Extremely halophilic archaebacteria (Halobacteriaceae) compensate for the high osmotic pressure of brines by high cytoplasmic K(+)-ion concentration. This requires appropriate adaptations of both the intracellular and extracellular functional macromolecules. Only some of the halophilic, halotolerant, and extremely halophilic eubacteria use this strategy, whereas the majority of them, as well as the halophilic algae, synthesize and accumulate in their cells organic compatible solutes (mono-, disaccharides, glycosyl-, glycerols, sugar alcohols, amino acids, and betaines). These compounds protect enzymes in addition to providing water-binding activity. In the eubacteria the most important compatible solute is glycine betaine. Another example is ectoine, for which both functions and biosynthetic pathways remain to be elucidated. (Author's abstract)
W87-05552

LIFE ABOVE THE BOILING POINT OF WATER,
Regensburg Univ. (Germany, F.R.). Lehrstuhl fuer Mikrobiologie.
K. O. Stetter, G. Fiala, R. Huber, G. Huber, and A. Segerer.
Experientia EXPEAM, Vol. 42, No. 11/12, p

1187-1191, December 1986. 6 fig, 3 tab, 25 ref.

Descriptors: *Thermophilic bacteria, *Bacterial physiology, *Temperature effects, Metabolism, Boiling, Growth, Aquatic habitats.

Characteristics of thermophilic bacteria are discussed, including habitats, metabolism, and morphology, and the prerequisites and limits of extremely thermophilic life are discussed. Various extremely thermophilic archaebacteria exhibit optimum growth at above 80 C. Pyrodictium is the most thermophilic of these organisms, growing at temperatures of up to 110 C and exhibiting optimum growth at about 105 C. Diverse types of anaerobic and aerobic metabolism are employed by all these thermophiles. Although the upper temperature limit for life is still unclear, it is probably much lower than 250 C, possibly in the range between 110 and 150 C. (Rochester-PTT)
W87-05553

BEHAVIOR OF 226RA IN THE MISSISSIPPI RIVER MIXING ZONE,
Texas A and M Univ., College Station. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W87-05557

EFFECTS OF HERBICIDE APPLICATION ON MORTALITY AND DISPERSIVE BEHAVIOR OF THE WATER HYACINTH WEEVILS, NEOCHETINA EICHHORNIAE AND NEOCHETINA BRUCHI (COLEOPTERA: CURCULIONIDAE),
Florida Univ., Gainesville. Dept. of Entomology and Nematology.
For primary bibliographic entry see Field 5C.
W87-05583

ARYL HYDROCARBON HYDROXYLASE LEVELS IN HERRING GULL EMBRYOS FROM DIFFERENT LOCATIONS ON THE GREAT LAKES,
National Wildlife Research Centre, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W87-05619

FATE OF THREE PHOSPHATE ESTER FLAME RETARDANTS IN SMALL PONDS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W87-05623

METABOLIC DIVERSITY AND ACTIVITY OF HETEROTROPHIC BACTERIA IN GROUND WATER,
Dayton Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 2F.
W87-05634

ACUTE TOXICITY OF CADMIUM, COPPER, MERCURY AND ZINC TO TROPOCYCLOPS PRASINUS MEXICANUS (CYCLOPOIDA, COPEPODA) FROM THREE QUEBEC LAKES,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W87-05649

FIELD STUDY OF PHYSIOLOGICAL EFFECTS ON FISH IN LEAD-CONTAMINATED LAKES,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
For primary bibliographic entry see Field 5C.
W87-05660

DIATOMS IN DAPHNID CULTURE AND BIOASSAY,
New Jersey Agricultural Experiment Station, New Brunswick.
K. I. Keating, and B. C. Dagbusan.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 299-307, March 1986. 4 fig, 23 ref. NSF Grant DEB 7823258.

Descriptors: *Diatoms, *Daphnids, *Cultures, *Bioassay, *Diets, *Nutrients, Algae, Toxicity, Cladocera.

For daphnids, the diatom Nitzschia frustulum is both a nutritionally desirable food and a source of essential organics not adequately provided by several green algae commonly fed daphnids in bioassays. Although a diet based on only one alga, Chlamydomonas reinhardti, generated more progeny per individual Daphnia pulex, progeny from broodmates fed diets differing only in that they also included diatoms were consistently more tolerant in acute toxicity bioassays. Feeding studies and bioassays were done in wholly defined inorganic media (MS system) that had contributed all essential inorganic nutrients for more than 100 consecutive generations of test daphnids. This limited the possibility of misinterpretation due either to deficiencies resulting from the absence of essential inorganics or to variations in media. Algae were grown in wholly defined inorganic media, versions of A-MS (algal version) that were similar to animal media excepting that additional N, P and Si, and the three vitamins (B12 thiamine, biotin) known to be needed by many algae were included. (Author's abstract)
W87-05662

ECOLOGICAL PERSPECTIVE ON FLOOD MITIGATION,
Kansas State Univ., Manhattan. Div. of Biology.
For primary bibliographic entry see Field 2E.
W87-05719

UNDER WATER MAPPING RIVER CHANNELS AND RESERVOIRS,
Water and Power Resources Service, Denver, CO.
For primary bibliographic entry see Field 7B.
W87-05749

SEDIMENT STUDIES IN GRAND CANYON, ARIZONA,
Geological Survey, Tucson, AZ.
For primary bibliographic entry see Field 2J.
W87-05798

EFFECT OF IMPOUNDMENTS ON NUTRIENT CONCENTRATIONS,
Agricultural Research Service, Durant, OK.
R. G. Menzel, S. J. Smith, and N. H. Welch.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 357-366, 2 fig, 5 tab, 18 ref.

Descriptors: *Nutrients, *Reservoirs, *Little Washita River, *Oklahoma, Nitrogen, Nitrates, Ammonium, Kjeldahl procedure, Phosphorus, Watershed.

A three year study in the Little Washita River Basin (53,900 ha) in Oklahoma evaluated the effect of Soil Conservation Service (SCS) flood detention reservoirs on nutrient concentrations in surface water on an agricultural watershed. Concentrations of nitrate N, ammonium N, Kjeldahl N, soluble P and total P were determined in runoff from upland source areas, inflows to two reservoirs, impounded water, outflows from the reservoirs, and downstream from the reservoirs. Concentrations in runoff from selected upland source areas (0.55 to 4.15 ha) were similar to those in inflows to the reservoirs from watershed areas of 28 and 400 ha. The impounded water and outflows from the reservoirs had lower concentrations of all nutrient forms except ammonium N. Total N and total P concentrations in the outflows were about 20% and 5%, respectively, of those in the inflows. However, nutrient concentrations in water 7.5 km or 10 km downstream from the reservoirs were similar to those in upland source areas. Even though 51% of the Little Washita River Basin is controlled by SCS impoundments, there was no apparent reduction in nutrient concentrations in the stream. (See also W87-05791) (Author's abstract)
W87-05828

BENTHOS IN A SEDIMENT-LADEN DELTA STREAM SYSTEM,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W87-05831

HYPSOGRAPHS: BASIC TOOLS FOR LAKE MANAGEMENT AND MONITORING,
Environmental Protection Agency, Washington, DC. Office of Water Planning and Standards.
L. E. Keup, and P. M. Tobin.
Environmental Management EMNGDC, Vol. 10, No. 5, p 623-627, September 1986. 2 fig, 1 tab, 3 ref.

Descriptors: *Limnology, *Hypsographs, *Lakes, *Lake morphology, Management planning, Mass balances, Monitoring.

Measurements of lake or reservoir constituents are common activities in the management of these waters and their contents. Quantitative data are required for many decisions involving limnology, fisheries, engineering, etc. but reliable and usable calculations cannot be performed without weighting data relative to the portions of lake water the values represent. Average values may have little use or meaning. The hypsograph is a tool that facilitates quantitative divisions of a lake into desired water mases. This then permits calculations of chemical masses (loads), productivity data, life supporting zones, etc. Hypsographs are graphic depictions of the vertical distributions of volumes or masses of water in lakes, ponds, or reservoirs. Quantitative limnological science or engineering must use a hypsograph, or a more complex equivalent system, to undertake calculations of water constituent concentration data by mathematical weighting. Construction of the graph is simple and based on the hydrographic map of a lake or reservoir. A hypsograph curve is a plot of depth (X) versus area (X squared), thus the area within the plot represents volume (X cubed). The shape of the curve represents the distribution of the volume with depth. It is scaled to the horizontal areas and vertical depths. (Authors' abstract)
W87-05873

REGIONAL REFERENCE SITES: A METHOD FOR ASSESSING STREAM POTENTIALS,
Northrop Services, Inc., Corvallis, OR.
R. M. Hughes, D. P. Larsen, and J. M. Omernik.
Environmental Management EMNGDC, Vol. 10, No. 5, p 629-635, September 1986. 1 fig, 2 tab, 31 ref. EPA Contract 68-03-3124.

Descriptors: *Model studies, *Watersheds, *Control sites, *Ecosystems, *Stream classification, Land classification, Classification, Assessments, Comparison studies, Water pollution control, Pollution index.

The objective of Congressional acts and agency regulations 'to restore and maintain the chemical, physical, and biological integrity of the Nation's waters' depends on models of attainable conditions, that is to say, some measurable objectives toward which cleanup efforts are striving. Field assessments of impacted streams require a control or at least an unbiased estimate of attainable conditions. Control sites, such as upstream/downstream or wilderness sites, have proven inadequate for assessing attainable ecological conditions where the control streams differ naturally from the impacted streams to a considerable degree or where different disturbances exist than those being studied. Relatively undisturbed reference sites with watersheds in areas having the same land-surface form, soil, potential natural vegetation, and land use as are predominant in large, relatively homogeneous regions are suggested as alternative control sites. These areas are considered typical of the region and therefore the sites also are considered typical of the region because their watersheds exhibit all

the terrestrial variables that make that region a region. The logical basis for developing regional reference sites lies in the ability to group watersheds and common stream types into regions by integrating available maps of terrestrial variables that influence streams. Relatively undisturbed reference sites can be selected from typical areas of the regions and from transition zones where one or two of the terrestrial variables are not the predominant one(s) of the region. These reference sites are useful for estimating attainable conditions, for evaluating temporal and spatial changes in ecological integrity, for classifying attainable uses of streams, and for setting biological and environmental criteria. (Authors' abstract)
W87-05874

ION REGULATION BY THE RAINBOW TROUT, SALMO GAIRDNERI, IN ION-POOR WATER,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
D. G. McDonald, and M. S. Rogano.
Physiological Zoology PHZOA9, Vol. 59, No. 3, 318-331, May-June 1986. 9 fig, 1 tab, 38 ref.

Descriptors: *Rainbow trout, *Ion regulation, *Ion-poor water, *Fish physiology, *Water quality, Atomic absorption spectroscopy, Physiological analysis, EDTA, Ion flux, Bioaccumulation.

The effects on hard-water-adapted rainbow trout of prolonged exposure to low external ion levels is described. In net ion flux experiments, trout were maintained in flux chambers for 2 days in normal hard water, and 14 days in soft water. In branchial unidirectional flux experiments, trout were fitted with dorsal aorta and urinary bladder catheters. Flux periods were 6 h long. Na(+) and Cl(-) uptake in relation to external NaCl was determined on uncatheterized trout. Radiotracers for Na(+) and Cl(-) were added to the external medium. A terminal blood sample was taken for the determination in plasma of NaCl and 22Na36Cl. As an indirect evaluation of Ca-binding activity of the gills, trout were exposed to EDTA for a 3.5-h period. Atomic absorption spectroscopy was used for the analysis of Na(+), K(+), and Ca (2+) in water, plasma, and urine. Radiotracers were separated by differential gamma and beta counting on a gamma counter and a scintillation counter. High energy beta emitters were separated with dual label quench correction program. Net losses of NaCl but not of Ca(2+) occurred. The gills were the predominant site of the net NaCl losses. Rates of loss declined with time, but initial ion balance was not restored except in animals maintained at threefold higher NaCl levels. The compensatory reduction in ion loss rate occurred because of an initial decline in brachial efflux and a later increase in both Na and Cl transport. Urine flow rate increased significantly as a result of low ion exposure but subsequently declined to levels typical of normal hard water. Mannitol clearance was unaffected by soft-water exposure. EDTA was effective in increasing ionic permeability of both hard-water-and soft-water-adapted fish. (Main-PTT)
W87-05890

SENSITIVE PERIODS FOR THE INFLUENCE OF THE HYDRIC ENVIRONMENT ON EGGS AND HATCHLINGS OF PAINTED TURTLES (CHRYSEMYS PICTA),
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
W. H. N. Gutzke, and G. C. Packard.
Physiological Zoology PHZOA9, Vol. 59, No. 3, 337-343, May-June 1986. 1 fig, 4 tab, 22 ref.

Descriptors: *Painted turtles, *Turtle eggs, *Turtle hatchlings, Cherry County, Nebraska, *Animal metabolism, Hatching success, Egg incubation, Soil moisture, Available water.

The effects of exposing eggs of painted turtles, Chrysemsy picta, to various hydric conditions during certain periods of embryonic development was examined. Eggs were incubated in wet and dry environments. Half of the eggs in each treatment were transferred to the other treatment at the end of the first trimester, and a similar shift was performed at the end of the second. The influence of the hydric environment on hatching success, on duration of incubation, and on size of hatchlings was confined to the last two-thirds of incuabtion because during the middle trimester, compensatory water exchanges occured. During the middle one-third of incubation, water uptake was greater and more rapid in a moist environment if an egg previously was in dry conditions. Likewise, water loss was more pronounced on a dry substrate during the middle trimester if an egg previously was in wet condiitons. No compensatory water exchange occured during the final trimester, but proximate hydric conditions during this period affected development. Because conditions in natural nests fluctuated during the incubation, findings presented raise doubts regarding the significance of nest-searching behavior reported for females of oviparious reptiles. (Main-PTT)
W87-05891

PREHISTORIC INFERRED PH CHANGES IN BATCHAWANA LAKE, ONTARIO FROM SEDIMENTARY DIATOM ASSEMBLAGES,
National Water Research Inst., Burlington (Ontario).
L. D. Delorme, H. C. Duthie, S. R. Esterby, S. M. Smith, and N. S. Harper.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 1, p 1-22, November 1986. 11 fig, 1 tab, 34 ref.

Descriptors: *Sediment cores, *Acid rain, *Paleoclimatology, *Hydrogen ion concentration, *Air pollution effects, *Paleolimnology, *Batchawana Lake, Ontario, Pollen, Acid rain, Podzols, Sediments, Diatoms, Benthic flora, History, Limnology, Lakes.

A number of changes in the pH of Batchawana Lake have occurred in the past. This lake, northeast of Lake Superior, Ontario, is within the Turkey Lakes Watershed, a region identified as sensitive to atmospheric loading because of geology and the low buffering capacity of the lakes. Batchawana Lake is situated in an area where the topographical relief is up to 300 meters. A hardwood forest grows on thin podzolic soil over metamorphosed metavolcanics. The lake is separated into two parts by an inactive beaver dam. The fossil diatom flora were studied to assess the paleolimnology of the lake and the impact of atmospheric loading over the last hundred years. From a core near the beaver dam the inferred pH is calculated at 5.7 near the bottom of the core and 6.0 for 1980 AD. However, there is evidence of a number of changes in the diatom flora and the tree pollen in the region during the interval represented by the core. The first change occurred at a depth of 53 cm as indicated by a change in the diatom flora, tree pollen concentration, and an increase in the dry weight of the sediments. The next change took place between 36.2 and 28.5 cm. The last major change occurred around 1830 AD. This latter change was the start of a decrease in inferred pH from 6.3 to 6.0. All of the changes appear to have been caused by changes in climate, not as a result of atmospheric loading. (Airone-PTT)
W87-05892

PHOSPHORUS AND CHLOROPHYLL CONCENTRATIONS IN LAKE MONATE (NORTHERN ITALY),
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
O. Ravera, D. Annoni, and M. F. Baudouin.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 1, p 23-44, November 1986.

Descriptors: *Limnology, *Water pollution sources, *Phosphorus, *Chlorophyll, *Water pollution effects, *Eutrophication, *Phytoplankton, *Lake Monate, Population dynamics, Italy, Conductivity, Transparency, Dissolved oxygen, Lakes.

The physical, chemical and biological characteristics of Lake Monate (Northern Italy) in 1969-1972 are compared with those of 1978-1980. During the period 1969-1972 the phosphorus concentration (< 10 microgram/l) and the phytoplankton population density were low and, consequently, this ecosystem has been classified as oligotrophic. This classification was also supported by the physical and chemical characteristics of the lake waters (temperature, transparency, dissolved oxygen, pH, electrical conductivity). After 1978 the phosphorus concentration increased (up to >70 microgram/l), but the chlorophyll concentration remained around 2 microgram/l. There is evidence that the phosphorus increase was an effect of the greater phosphorus loading from the human population living in the lake watershed - in fact, during the last 20 years the population increment was about 35% (Domestic wastewaters are presently the major load of phosphorus into the lake waters, about 85% of the total). The causes of why a higher chlorophyll concentration (as would be expected) did not follow the phosphorus increase are discussed. (Airone-PTT)
W87-05893

ALTERNATIVE APPROACH TO STUDY THE AVOIDANCE OF DUCKWEED (LEMNA GIBBA L. - L. MINOR L. COMPLEX) FROM ARID ZONES,
Science and Education Administration, Beltsville, MD.
D. Porath, and M. Agami.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 1, p 45-53, November 1986. 3 fig, 3 tab, 26 ref.

Descriptors: *Nutrients, *Bioaccumulation, *Deserts, *Duckweed, *Ammonium, *Arid zone, Israel, Manure, Nitrates, Phosphates, Organic wastes, Aquatic plants.

Duckweed is not found extensively in aquatic habitats within arid zones. However, outdoor experiments in the Negev desert highlands revealed that Lemna gibba L. establiahes well on NH4(+)-containing mineral growth solution or on diluted organic wastes. In the margin of the Judean desert several water cisterns which are utilized by local herds are usually covered by a duckweed mat of Lemna gibba L.- Lemna minor L. complex. Other natural water habitats in the Negev and Sinai deserts are devoid of duckweed. Chemical analysis of the water of 15 aquatic habitats revealed that ammonium ion (NH4(+)) and not nitrate (NO3(-)) levels correlate with duckweed establishment and that phosphate (PO4(3-)) levels ar about optimum for duckweed development. The results led to the assumption that preferential NH4(+) uptake characteristic for several duckweed species has an ecophysiological significance in the distribution of duckweed in arid zones. Factors which may limit the establishment of duckweed (e.g., detergents) are discussed. Climatic factors and seed set conditions become less decisive for duckweed establishment in deserts. The very low amount of nitrate found in natural aquatic habitats of the Negev highlands indicates indirectly that the hydrophytes and hygrophytes probably absorb their nitrogen from the soil and not from the water as has been found in other cases. (Airone-PTT)
W87-05894

PHOTOSYNTHATE PARTITIONING: A LABILE, ADAPTIVE PHENOMENON IN MICROCYSTIS AERUGINOSA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
T. D. Olesen, and G. G. Ganf.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 1, p 55-76, November 1986.

Descriptors: *Protein synthesis, *Light intensity, *Photosynthesis, Respiration, Lakes, Phytoplankton, Cultures, Nutrients.

The relationships between growth (increase in cell numbers), photosynthesis, respiration, protein synthesis, and carbohydrate production for nutrient saturated batch cultures of Microcystis aeruginosa Kuetz emend Elenkin were studied in order to elucidate factors in the growth success of some species in relation to others. Both dark and light processes were considered. Short term (1-2 h) measurements of photosynthesis were shown to be representative of the rates occurring throughout the photo period, regardless of prior conditioning. For cultures grown under constant daylength

(10:14 L:D) and photon flux (300 micromoles/sq m/s and exposed to a range of photon fluxes, the carbohydrate pool diminished at low irradiance but increased exponentially as photosynthesis increased. In contrast, protein synthesis asymptoted. Consequently, a greater proportion of the carbon fixed at low rates of photosynthesis was directed toward protein synthesis than to carbohydrate. At higher rates of photosynthesis the converse occurred. During the photoperiod there was a close relationship between protein synthesis and cell division. Respiration during the dark period correlated linearly with carbohydrate concentration per cell at the end of the light period. Changes in carbohydrate concentration during the dark period were related linearly to protein synthesis and cell division, and the specific growth rate correlated linearly with respiration. Although carbohydrate per cell fluctuated greatly, cell protein content remained constant throughout the 24 h. Photosynthesis of cultures preadapted to the conditions of exposure (1:23 to 24:0 L:D, 5-120 micromoles/sq m sec) was highest at a short photoperiod (62.8 fmoles O2/cell h) and least under continuous light. This trend was reflected by the rate of carbohydrate synthesis. There was no change in protein content per cell, as the rate of protein synthesis corresponded to the specific growth rate. Specific growth rates over 24 h increased with daylength. However, rates corrected for light received showed the reverse trend. A comparison between rates of photosynthesis and photosynthesis to respiration ratios in three cultures adapted to different conditions showed that Micro cystis responded to changes in the light climate. (Author's abstract)
W87-05895

DRAGONFLIES AS INDICATORS OF THE CONDITIONS OF RUNNING WATERS IN THE LOWER PARTS OF NORTHWESTERN GERMANY (LIBELLEN ALS INDIKATOREN DES ZU STANDES VON FLIESSGEWAESSERN DES NORDWESTDEUTSCHEN TIEFLANDES),
Technische Univ. Braunschweig (Germany, F.R.). Zoologisches Inst.
G. Rehfeldt.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 1, p 77-95, November 1986. 5 fig, 5 tab, 46 ref.

Descriptors: *Streams, *Running waters, *Dragonflies, *Bioindicators, Channeling, Conductivity, Species composition, Marcophytes.

The species composition of adult dragonfly fauna, and the hydrochemical variables, degree of channelization, and structure of the surrounding areas of 35 brooks were investigated at 118 sites in Eastern Lower Saxony. Similarities in the distribution of stream-dwelling odonates and aquatic macrophytes of the brook Lachte are shown in longitudinal profile and in a dendrogram. Only 50% of the indigenous species are found as larvae, so counts of adults are better suited for a representative record of species composition. Specific conductivity is found to be a useful measure of sewage effluent in the geologically homogeneous study area. The distribution of species in relation to distance from the headwaters and to given parameters yields a classification scheme which allows the prediction of the development of coenosis and an evaluation of the conditions of lowland waters in Northwestern Germany. Calopteryx virgo, Cordulegaster boltoni, and Ophiogomphus serpentinus are regarded as useful indicators for natural brooks. Combined studies of dragonflies and aquatic macrophytes are proposed as bioindicator systems for the classification of waters. (Author's abstract)
W87-05896

HABITAT USE, GROWTH, AND FEEDING OF PIKE (ESOX LUCIUS L) IN FOUR NORWEGIAN LAKES,
Metro Wastewater, San Diego, CA.
L. A. Vollestad, J. Skurdal, and T. Qvenild.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 1, p 107-117, November 1986. 5 fig, 2 tab, 32 ref.

Descriptors: *Lakes, *Limnology, *Food habits, *Pike, *Predation, *Food chains, *Fish growth, Ecosystems, Norway, Prey size, Turbidity, Diets, Species composition.

Pike from four lakes differing in size and productivity were studied in order to determine the factors which control growth differences. Pike were caught using gill nets, measured, the cleithra collected for age determination, and the stomach contents identified. The pike were mainly littoral. The fraction of pelagic pike increased with increasing turbidity. Growth was rapid in the deep, oligotrophic-mesotrophic Lake Tyrifjorden where whitefish up to 30-34 cm was the most common prey. In the three mesotrophic-eutrophic lakes in the Halden River system growth was slower, and small fish (<15 cm) such as smelt Osmerus eperlanus and ruffe Acerina cernua were the main sprey species. Epilimnet summer temperatures could not explain these growth differences. The growth rate was highest in the lake with the lowest prey abundance. It is concluded that the slower growth of pike in the Halden River system may be explained in three ways. First, capture cost may be higher in turbid waters of the Halden system (but then the negative effects of high turbidity must be larger than the positive effect of high prey density). Second, low availability of suitable prey larger than 15 cm may reduce growth, or species composition of prey may have a direct effect on pike growth. Third, there may be genetic differences between pike from the different areas. The explanations are not mutually exclusive. (Airone-PTT)
W87-05897

DISSOLVED ORGANIC CARBON DYNAMICS IN TWO SUBTROPICAL BLACKWATER RIVERS,
Georgia Univ., Athens. Dept. of Zoology.
J. L. Meyer.
Archiv fuer Hydrobiologie AHYBA4, Vol. 108, No. 1, p 119-134, November.

Descriptors: *Dissolved organic carbon, *Humic acids, *Seasonal variation, *Rivers, Georgia, Leaching, Flood plains, Watersheds, Transport, Export, Photolysis, Accumulation.

The seasonal pattern of DOC concentration and transport was studied in the sixth order Ogeechee River and its fourth order tributary, Black Creek, two low-gradient blackwater rivers in Georgia, U.S.A. Samples were collected from the main channel and backwater areas at varying intervals during 1981-1985. Samples were ultrafiltrated to determine the molecular weight distribution. A separate experiment measured the influence of photolysis on concentration and quality of DOC. Carbohydrate and phenol analysis was performed on one set of samples. Mean annual DOC concentration was higher in Black Creek, but in both rivers over half of the DOC was of intermediate molecular weight (1000-10000 nMW). Although the magnitude of Doc concentration and export differed between the two rivers, the seasonal pattern was similar, with highest concentration and export during winter flooded conditions and lowest during summer. Concentration increased as discharge increased, although this relationship was not as strong for low (<1000 nMW) and high (>10000 nMW) molecular weight DOC as it was for the intermediate (1000-10000 nMW) fraction. DOC transport per unit watershed area was greater from Black Creek than from the Ogeechee, and both were considerably greater than values measured from forested upland watersheds. Export of the low molecular weight DOC was similar to values of total organic carbon exported from upland watersheds. Leaching of DOC from productive floodplain forests appears to be one reason for the higher DOC transport in these rivers. Once in the river, processes such as differential biological uptake appear to influence DOC concentration and quality. It is unlikely that photolysis is a major sink for DOC in these rivers. (Airone-PTT)
W87-05898

OPTIMIZATION OF THE ELECTRON TRANSPORT SYSTEM (ETS) METHOD FOR NATURAL PHYTOPLANKTON ASSEMBLAGES TESTED WITH SOME SPECIES OF FRESHWATER PHYTO-PLANKTON,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
A. S. W. Span.
Water Research WATRAG, Vol. 20, No. 12, p 1497-1503, December 1986. 3 fig, 2 tab, 24 ref.

Descriptors: *Phytoplankton, *Surface water, *Biological communities, *Respiration, Membrane filters, Reproducibility, Optimization, Experimental design.

An optimization of the ETS method is presented for whole freshwater plankton communities, as well as size-fractionated community samples. The following parameters were studied: filter type and removal system, reproducibility, sonication, stability, effect of light on ETS, and the relative importance of three substrates, Scenedesmus quadricauda, Chlamydomonas reinhardtii, and Stephanodiscus hantzschii. (A fourth substrate, Oscillatoria agardhii, was included in parts of the experiment). The reproducibility and recovery of the method is very good when membrane filters are used and the concentrated sample is removed from the filter by brush. Three to five minutes appear to be sufficient to release ETS activity. The effect of light on ETS activity appears to be negligible. The following conditions should be observed: the processed sample stored for not longer than 30 min. on ice, extinction must not be higher than 0.6, reaction time no longer than 30 min., and no 'hard' species must dominate the water sample. The recovery of the size-fractionated water sample, based on the activity of the whole sample, was not significantly different from 100% at the level of P=0.01. (Airone-PTT)
W87-05907

VARIATION OF ATP CONTENT IN SCENEDESMUS DIMORPHUS CELLS GROWN IN A CHEMOSTAT CULTURE AND ITS COMPARISON WITH CHLOROPHYLL-A CONTENT,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
S. Kunikane, M. Kaneko, and R. Maehara.
Water Research WATRAG, Vol. 20, No. 12, p 1569-1574, December 1986. 7 fig, 1 tab, 12 ref.

Descriptors: *Adenosine triphosphate, *Chlorophyll, *Algal growth, *Bioassay, Phosphorus, Nitrogen, Bioindicators, Growth kinetics, Algae, Chemostat, Biomass, Eutrophication, Limiting nutrients, Biomass.

The variations of ATP and chl-a content in Scenedesmus dimorphus cells grown in a chemostat culture under nutrient limitation were investigated in order to assay the availability of ATP as an indicator of algal biomass. ATP and chl-a contents per algal dry weight varied in the ranges of 0.15-1.64 microgram/mg (0.33-3.82 microg/mg as ATP/C ratio) and 0.32-1.32% (7.8-30.8 microgram/mg as chl-a/C ratio), respectively, under the conditions of T-N/T-P ratio of 2-50 by weight and dilution rate of 1-4 per day. At every T-N/T-P ratio, both ATP and chl-a contents increased as dilution rate increased. At a given dilution rate, ATP content decreased systematically as T-N/T-P ratio increased, with the one exception at dilution rate of 4 per day. It appears that ATP and chl-a can hardly be used successfully as indicators of algal biomass. (Author's abstract)
W87-05916

ENVIRONMENTAL MODIFICATION OF THE PHOTOSYNTHETIC RESPONSE OF LAKE PLANKTON TO SURFACTANTS AND SIGNIFICANCE TO A LABORATORY-FIELD COMPARISON,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
For primary bibliographic entry see Field 5C.
W87-05917

BACTERIAL GLUCOSE MINERALIZATION IN ACID-STRESSED LAKE SEDIMENTS,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
C. G. Choquet, L. G. Leduc, and G. D. Ferroni.

Water Research WATRAG, Vol. 20, No. 12, p 1583-1587, December 1986. 6 fig, 1 tab, 23 ref.

Descriptors: *Mineralization, *Lake sediments, *Acid rain, *Water pollution effects, *Glucose, Heterotrophic bacteria, Seasonal variation, Benthic fauna, Microbial degradation, Radioactive tracers, Bacteria, Incubation, Lakes, Sediments, Acidic water.

Glucose mineralization by the benthic microbiota of acid-stressed Silver Lake, Ontario, Canada was quantitated as a function of season. Attempts were also made to measure the mineralization response when the microbiota were subjected to near neutral pH conditions. Comparisons made on the basis of V sub max values revealed that the heterotrophic potential varied according to season, being lowest during winter and highest during summer (0.224 and 0.993 microgram/g h, water temperature 4 and 17 C, respectively). Also, an unexpected decrease in heterotrophic potential was realized for all samplings at an experimental, circum neutral pH. These results, along with observed, higher bacterial cell counts at the experimental pH, indicate that a fraction of the heterotrophic population is incapable of glucose mineralization at the higher pH, and are evidence for the existence of acidophilic bacteria in acid stressed aquatic environments. Pre-incubation studies showed that the differences in heterotrophic potentials persisted for up to 15 days, the longest pre-incubation period examined. (Author's abstract)
W87-05918

2I. Water In Plants

HERBICIDE EFFECTS ON WATER USE BY GRASS SOD AND RED CLOVER (TRIFOLIUM PRATENSE) ESTABLISHMENT,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W87-05261

PROTEIN CONTENTS OF SEED YIELDS OF FIELD-GROWN SOYBEANS EXPOSED TO SIMULATED ACIDIC RAIN: ASSESSMENT OF THE SENSITIVITIES OF FOUR CULTIVARS AND EFFECTS OF DURATION OF SIMULATED RAINFALL,
Manhattan Coll., Bronx, NY. Lab. of Plant Morphogenesis.
For primary bibliographic entry see Field 5C.
W87-05264

YIELD RESPONSE OF DAVIS SOYBEANS TO SIMULATED ACID RAIN AND GASEOUS POLLUTANTS IN THE FIELD,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-05265

EMISSION OF ETHYLENE BY OAT PLANTS TREATED WITH OZONE AND SIMULATED ACID RAIN,
Pennsylvania State Univ., University Park. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5C.
W87-05266

LEAF-SURFACE PROPERTIES IN RELATION TO TOLERANCE OF SALT SPRAY IN FESTUCA RUBRA SSP. LITORALIS (G. F. W. MEYER) AUQUIER,
Welsh Plant Breeding Station, Aberystwyth.
For primary bibliographic entry see Field 3C.
W87-05267

TOLERANCE OF SODIUM CHLORIDE AND ITS GENETIC BASIS IN NATURAL POPULATIONS OF FOUR GRASS SPECIES,
Liverpool Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 3C.
W87-05268

EFFECTS OF WASTEWATER FROM OLIVE PROCESSING ON SEED GERMINATION AND EARLY PLANT GROWTH OF DIFFERENT VEGETABLE SPECIES,
Consejo Superior de Investigaciones Cientificas, Grenada (Spain). Dept. de Quimica Agricola y Fisiologia.
For primary bibliographic entry see Field 5C.
W87-05277

SEATTLE'S DIVERSIFIED APPROACH TO SLUDGE USE,
Seattle Sludge Management Program, WA.
For primary bibliographic entry see Field 5E.
W87-05301

SYNERGISTIC EFFECTS OF ACID RAIN AND (+ OR -)-2-(2,4-DICHLOROPHENOXY) PROPANOIC ACID (2,4 DP) ON GROWTH, MINERAL CONTENT AND STRESS-INDUCED ETHYLENE IN LETTUCE,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
For primary bibliographic entry see Field 5C.
W87-05310

TEMPERATURE AND LEAF OSMOTIC POTENTIAL AS FACTORS IN THE ACCLIMATION OF PHOTOSYNTHESIS TO HIGH TEMPERATURE IN DESERT PLANTS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
J. R. Seemann, W. J. S. Downton, and J. A. Berry.
Plant Physiology PLPHAY, Vol. 80, No. 4, p 926-930, April 1986. 6 fig, 1 tab, 22 ref. USDA Grant 78-59-2115-0-128.

Descriptors: *Photosynthesis, *Water potential, *Osmosis, *Desert plants, *Thermal stress, *Leaves, Seasonal variation, Temperature, Tolerance, Plant physiology, Death Valley, California, Chlorophyll.

Seasonal changes in the high temperature limit for photosynthesis of desert winter annuals growing under natural conditions in Death Valley, California were studied using an assay based upon chlorophyll fluorescence. All species of this group were 6 to 9 C more tolerant of high temperature at the end of the growing season (May), than at its beginning (February). Over this same time period, the mean daily maximum air temperature increased by 12 degrees C. Laboratory studies have demonstrated that increases in thermal tolerances could be induced by increasing growth temperature alone. For plants growing under field conditions there was also a good correlation between the thermal tolerance of leaves and the osmotic potential of leaf water, indicating that increases in the concentrations of sorbitol could be demonstrated to have increased thermal tolerance. (Author's abstract)
W87-05317

PROLINE ACCUMULATION AND THE ADAPTATION OF CULTURED PLANT CELLS TO WATER STRESS,
Purdue Univ., Lafayette, IN. Dept. of Horticulture.
For primary bibliographic entry see Field 2D.
W87-05318

DROUGHT AVOIDANCE STRATEGY IN CERATONIA SILIQUA L., A MESOMORPHIC-LEAVED TREE IN THE XERIC MEDITERRANEAN AREA,
Messina Univ. (Italy). Ist. di Botanica.
For primary bibliographic entry see Field 2D.
W87-05342

ENVIRONMENTAL PARAMETERS REGULATING GASEOUS NITROGEN LOSSES FROM TWO FORESTED ECOSYSTEMS VIA NITRIFICATION AND DENITRIFICATION,
North Carolina State Univ. at Raleigh. Dept. of Forestry.
For primary bibliographic entry see Field 2G.
W87-05394

EVALUATION OF GREEN ASH ROOT RESPONSES AS A SOIL WETNESS INDICATOR,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
For primary bibliographic entry see Field 2G.
W87-05421

STRESS TOLERANCE AND ADAPTATION IN SPRING WHEAT,
Georgia Univ., Athens. Dept. of Agronomy.
P. L. Bruckner, and R. C. Frohberg.
Crop Science CRPSAY, Vol. 27, No. 1, p 31-36, January-February 1987. 5 tab, 13 ref.

Descriptors: *Plant physiology, *Stress tolerance, *Spring wheat, *Water stress, *Crop yield, *Temperature effects, Cultivars, Regression analysis, Estimating, Genotypes, Prediction.

Development of stress tolerant cultivars is an objective of many breeding programs, but success has been limited by inadequate screening techniques, and the lack of genotypes that show clear differences in response to well defined environmental stresses. Twenty spring wheat (Triticum aestivum L.) genotypes were evaluated over a range of water and high temperature-stressed environments (15 location-years) to establish standards for evaluation of stress tolerance screening techniques and to characterize genotypic stress tolerance and adaptation to stress environments. Overall and postanthesis stress tolerances were determined using grain yield and kernel weight responses, respectively. Stress tolerances were estimated using stress susceptibility indices (S), grain yields and kernel weights predicted for a hypothetical severe-stress environment from regression parameters, and yields and kernel weights per se in five stress environments. Yield-based stress tolerance estimates were correlated among all estimation methods. The stress susceptibility index identified stress tolerant genotypes that did not have outstanding yield performance per se in stress environments due to low yield potential, but which minimized yield loss under stress conditions. Kernel weight-based estimates of postanthesis stress tolerance using S were not correlated with predicted kernel weights in a hypothetical severe-stress environment or with kernel weights per se in five stress environments. Genotypes evaluated in this study exhibited a wide range in stress tolerance and adaptation to stress-prone environments. Stress tolerant and susceptible genotypes were identified to use in evaluation of stress tolerance screening techniques. Used in tandem, regression analyses of genotype x environment interactions, stress susceptibility indices, and stress performance per se, provided a more complete description of genotype stress tolerances than did any analysis used alone. (Author's abstract)
W87-05430

EFFECTS OF AIR TEMPERATURE AND WATER STRESS ON APEX DEVELOPMENT IN SPRING WHEAT,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
A. B. Frank, A. Bauer, and A. L. Black.
Crop Science CRPSAY, Vol. 27, No. 1, p 113-116, January-February 1987. 1 fig, 2 tab, 13 ref.

Descriptors: *Air temperature effects, *Water stress, *Spring wheat, *Crop yield, *Apex development, *Plant growth, *Field tests, Reproduction, Growth, Regression analysis.

Grain yield of hard red spring wheat (HRSW) (Triticum aestivum L.) is influenced by the number of spikelets produced per spike. There is a need to better understand, for predictive purposes, the effects of water and temperature on apex differentiation, spike and spikelet development, and number of spikelets. The effects of these two factors on apex development and number of spikelets produced per spike were studied in a controlled environment using 'Sinton' HRSW. Data on spikelets per spike from field studies conducted at Mandan, ND were included to evaluate temperature effects during the spikelet development phase on number of spikelets formed per spike. Plants grown at 18 C

for 4, 8, or 12 days from emergence, and thereafter at 26 C required less time to reach double ridge and terminal spikelet development stage, had a shorter spikelet development period, and produced fewer spikelets per spike than plants grown initially at 26 C for 4, 8, and 12 days and thereafter at 18 C. These data indicated that higher air temperature (26 C) from about 6 to 8 days prior to apex double ridge through terminal spikelet formation reduced the number of spikelets per spike. Plants exposed to water stress starting 12 days after seedling emergence required the same duration to develop double ridges as the controls, but stressed plants had a shorter spikelet development stage, resulting in fewer spikelets per spike. The data suggested that the transition of the apex from vegetative to reproductive growth is a continuum. Regression analysis of spikelets per spike at the apex terminal spikelet stage on maximum daily air temperature during the spikelet formation period showed a significant negative linear relationship (R squared = -0.69). This relationship, along with application of growing-degree days for estimating the spikelet development period, has application for enhancing prediction of grain yields from number of spikelets produced per spike. (Author's abstract)
W87-05431

CANOPY TEMPERATURE BASED IRRIGATION SCHEDULING INDICES FOR KENTUCKY BLUEGRASS TURF,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W87-05432

IRRIGATION WITH BRACKISH WATER UNDER DESERT CONDITIONS: III. METHODS FOR ACHIEVING GOOD GERMINATION UNDER SPRINKLER IRRIGATION WITH BRACKISH WATER,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Boyko Inst. for Agriculture and Applied Biology.
For primary bibliographic entry see Field 3C.
W87-05438

IRRIGATION SCHEDULING EFFECTS ON YIELD AND PHOSPHORUS UPTAKE OF COWPEA,
Ministry of Agriculture, Jos (Nigeria).
For primary bibliographic entry see Field 3F.
W87-05439

RESPONSE OF WHEAT TO IRRIGATION WITH SMALL AMOUNTS OF WATER APPLIED IN VARIOUS WAYS,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
For primary bibliographic entry see Field 3F.
W87-05440

WITHIN-ROW IRRIGATION SAVES WATER ON CROPLANDS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W87-05443

WATER LOSSES THROUGH THE BUNDS OF IRRIGATED RICE FIELDS INTERPRETED THOUGH AN ANALOGUE MODEL,
Land Resources Development Centre, Surbiton (England).
For primary bibliographic entry see Field 3F.
W87-05445

WATER BALANCE AND PATTERN OF SOIL WATER UPTAKE IN A PEACH ORCHARD,
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
For primary bibliographic entry see Field 2D.
W87-05451

PHYCOBILIPROTEIN COMPOSITION AND CHLOROPLAST STRUCTURE IN THE FRESHWATER RED ALGA COMPSOPOGON COERULEUS (RHODOPHYTA),
Smithsonian Environmental Research Center, Rockville, MD.
For primary bibliographic entry see Field 2H.
W87-05478

EFFECT OF TREE CANOPY REMOVAL BY GYPSY MOTH LARVAE ON THE MACROALGAE OF A RHODE ISLAND HEADWATER STREAM,
Rhode Island Univ., Kingston. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W87-05483

RELEASE OF REDUCING SUGARS AND DISSOLVED ORGANIC CARBON FROM SPARTINA ALTERNIFLORA LOISEL IN A GEORGIA SALT MARSH,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W87-05484

QUANTITATIVE REPRODUCTION AND REPRODUCTIVE EFFORT BY STANDS OF THE BROWN ALGA ASCOPHYLLUM NODOSUM (L.) LE JOLIS IN SOUTH-EASTERN CANADA,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W87-05491

EFFECTS OF FREQUENCY OF IRRIGATION AND GYPSUM TREATMENT ON LEAF WATER POTENTIAL AND LEAF STOMATAL CONDUCTANCE OF LUCERNE (MEDICAGO SATIVA L.) GROWN ON A HEAVY CLAY SOIL,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 3F.
W87-05505

EFFECTS OF SALINE WATER IRRIGATION ON SOIL SALINITY, PECAN TREE GROWTH AND NUT PRODUCTION,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
For primary bibliographic entry see Field 5C.
W87-05506

SEEDLING MORTALITY OF SEVERAL CROPS INDUCED BY ROOT, STEM OR LEAF EXPOSURE TO SALTS,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
For primary bibliographic entry see Field 5C.
W87-05507

HORIZONTAL AND VERTICAL VARIABILITY IN THE DISTRIBUTION OF AQUATIC MACROPHYTES IN LAKE WAIKAREMOANA,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 2H.
W87-05516

EFFECT OF SOIL MOISTURE STRESS ON LEAF AREA INDEX, EVAPOTRANSPIRATION AND MODELED SOIL EVAPORATION AND TRANSPIRATION,
New Mexico State Univ., Las Cruces. Dept. of Mathematical Sciences.
For primary bibliographic entry see Field 2D.
W87-05521

RESPONSE OF LEAF GROWTH, LEAF NITROGEN, AND STOMATAL CONDUCTANCE TO WATER DEFICITS DURING VEGETATIVE GROWTH OF FIELD-GROWN SOYBEAN,
Commonwealth Scientific and Industrial Research Organization, Winnellie (Australia). Darwin Labs.
For primary bibliographic entry see Field 3F.
W87-05590

ANATOMICAL, MORPHOLOGICAL, AND PHYSIOLOGICAL RESPONSES OF ALFALFA TO FLOODING,
California Univ., Riverside. Dept. of Plant Pathology.
For primary bibliographic entry see Field 3F.
W87-05592

SALT TOLERANCE OF TWO DIFFERENTLY DROUGHT-TOLERANT WHEAT GENOTYPES DURING GERMINATION AND EARLY SEEDLING GROWTH,
Texas Tech Univ., Lubbock. Dept. of Biological Sciences.
For primary bibliographic entry see Field 3C.
W87-05593

INFLUENCE OF SALT STRESS ON BIOCHEMICAL PROCESSES IN CHICKPEA, CICER ARIETINUM L.,
Shivaji Univ., Kolhapur (India). Dept. of Botany.
For primary bibliographic entry see Field 3C.
W87-05594

PLANT WATER BALANCE,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
E.-D. Schulze, R. H. Robichaux, J. Grace, P. W. Rundel, and J. R. Ehleringer.
Bioscience BISNAS, Vol. 37, No. 1, p 30-37, January 1987. 7 fig, 57 ref.

Descriptors: *Plant physiology, *Plant water potential, *Available water, *Water requirements, *Evaporation, *Transpiration, *Reviews, Drought, Water use, Competing use, Atmosphere, Water vapor, Canopy, Leaves, Plant growth, Hydrologic budget.

The influence of water availability on plant performance in natural and managed ecosystems has been the subject of much research in plant physiological ecology and related disciplines. The control of water movement from the soil through plants to the atmosphere and the interaction of water vapor and heat transport between plants and the atmosphere have been studied extensively; recent and classical advances in these areas were reviewed. References were also cited for studies pertaining to mechanisms of adaptation to drought, ranging from decreases in canopy leaf area to increases in turgor maintenance capacity. Studies on the relationship between water balance, growth, and carbon partitioning, including the recent advances made at both the cellular and whole-plant levels, were also highlighted. Several research areas which are likely to yield significant insights in the near future, including new techniques for measuring water potential, turgor pressure and water content and new metabolic mechanisms, were detailed. (Wood-PTT)
W87-05595

STRESS PHYSIOLOGY AND THE DISTRIBUTION OF PLANTS,
Australian National Univ., Canberra. Dept. of Environmental Biology.
C. B. Osmond, M. P. Austin, J. A. Berry, W. D. Billings, and J. S. Boyer.
Bioscience BISNAS, Vol. 37, No. 1, p 38-48, January 1987. 5 fig, 90 ref.

Descriptors: *Plant growth, *Plant physiology, *Stress, *Reviews, Literature reviews, Abiotic stress, Plant populations, Populations, Environment. Temperature, Environmental effects, Available water, Salt tolerance, Salt rejection, Flooding, Light intensity, Lighting.

Plant stress is defined as any factor that decreases plant growth and reproduction below the genotype's potential. In this review concentration is focused on abiotic stresses and their impact on vascular plants. References to studies relating to stress caused by the environment and temperature, and that which is caused by various amounts of water, flooding, salt, or light are highlighted.

Present trends and future objectives of research are detailed. (Wood-PTT)
W87-05596

OCCURRENCE AND ECOLOGICAL SIGNIFICANCE OF VESICULAR ARBUSCULAR MYCORRHIZA IN THE SALT MARSH ENVIRONMENT,
Vrije Univ., Amsterdam (Netherlands). Dept. of Ecology and Ecotoxicology.
For primary bibliographic entry see Field 2L.
W87-05613

RYEGRASS ESTABLISHMENT AND YIELD IN RELATION TO PESTICIDE TREATMENT, IRRIGATION AND FERTILIZER LEVEL,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 3F.
W87-05614

PLANT WATER RELATIONS IN LYCHEE: EFFECTS OF SOLAR RADIATION INTERCEPTION ON LEAF CONDUCTANCE AND LEAF WATER POTENTIAL,
Queensland Dept. of Primary Industries, Nambour (Australia). Maroochy Horticultural Research Station.
C. M. Menzel, and D. R. Simpson.
Agricultural and Forest Meteorology, Vol. 37, No. 4, p 259-266, September 1986. 6 fig, 2 tab, 13 ref.

Descriptors: *Drought stress, *Productivity, *Lychee trees, *Leaves, *Water potential, *Solar radiation, Plant tissues, Plant growth, trees, Queensland, Australia, Transpiration, Photosynthesis, Crop yield.

Ecological and experimental evidence indicates that floral initiation in lychee is promoted by dry conditions which restrict vegetative growth during winter, while fruiting during summer is superior under wet and humid conditions. An understanding of how water stress affects lychee growth and how such responses can be manipulated at certain stages of the crop cycle for maximum productivity requires measurement of plant water status. In some species at least, position of the leaves or fruit in the crown can modify the level and diurnal pattern of water status measured. The effect of radiation interception on leaf conductance and leaf water potential in 6-yr old lychee trees was investigated during the dry season in subtropical Queensland, Australia. A high degree of exposure of leaves to direct radiation raised the leaf-air water vapor concentration gradient and resulted in lower leaf conductance and leaf water potential. Interior leaves of the south side of trees were less sensitive to atmospheric and radiation effects and are the best indicator of drought stress in lychee. Completely random or stratified sampling is necessary to estimate a true mean value for calculation of canopy transpiration or photosynthesis. (See also W87-05868) (Authors' abstract)
W87-05867

PLANT WATER RELATIONS IN LYCHEE: DIURNAL VARIATIONS IN LEAF CONDUCTANCE AND LEAF WATER POTENTIAL,
Queensland Dept. of Primary Industries, Nambour (Australia). Maroochy Horticultural Research Station.
C. M. Menzel, and D. R. Simpson.
Agricultural and Forest Meteorology, Vol. 37, No. 4, p 267-277, September 1986. 3 fig, 5 tab, 22 ref.

Descriptors: *Lychee, *Drought stress, *Productivity, *Leaves, *Water potentials, Stomata, Relative humidity, Mist irrigation, Queensland, Australia, Crop yield.

The lychee originated in subtropical China where temperatures during fruiting are warm and both relative humidity and rainfall are high. The fruiting period of lychee in subtropical Australia is characterized by low humidity and low rainfall. Excessive rates of fruit abscission and low yields suggest that trees are stressed during this critical period of development. Diurnal variations in leaf conductance and leaf water potential were investigated in 6-yr old lychee trees during the dry season in subtropical Queensland, Australia. Leaf conductance and leaf water potential fell from morning to the middle of the day and then recovered slowly during the afternoon. Most of the variation in leaf conductance and leaf water potential could be attributed to a negative response to leaf-air water vapor concentration gradient. The marked sensitivity of lychee stomata to relative humidity suggests that CO2 assimilation could be reduced dramatically at high vapor concentration gradient and is one of the possible explanations for the poor fruit retention of lychee in dry environments. It is possible that the productivity of lychee at low humidities could be improved by techniques which decrease leaf-air vapor concentration gradient, such as overhead intermittent misting. (See also W87-05867) (Authors' abstract)
W87-05868

EFFECTS OF POPULATION DENSITY AND INTERCROPPING WITH COWPEA ON THE WATER USE AND GROWTH OF SORGHUM IN SEMI-ARID CONDITIONS IN BOTSWANA,
Agricultural Research Station, Gaborone (Botswana). Dryland Farming Research Scheme.
D. J. Rees.
Agricultural and Forest Meteorology, Vol. 37, No. 4, p 293-308, September 1986. 11 fig, 4 tab, 23 ref.

Descriptors: *Cowpea, *Semiarid climates, *Evapotranspiration, *Plant growth, *Sorghum, *Soil water, Crop production, Cropland, Evapotranspiration potential, Botswana, Drought, Population density.

In the semi-arid climate of Botswana variability in rainfall amount and distribution results in considerable variations in crop production. In such an environment an understanding of the effects of cultural practices on crop water use and water use efficiency is particularly important if these practices are to be tailored to the environment. Soil moisture was measured below sorghum crops of differing density in rainfed trials in increasingly droughty conditions from 1981-82 to 1983-84. Additional measurements were made in sorghum/cowpea intercrops and cowpea monocrops during the drought seasons of 1982-83 and 1983-84. Increasing crop density, by addition of either sorghum or cowpea, resulted in increased effective root activity, which was accompanied by small increases in actual/potential evapotranspiration early in each season. These small increases were followed by small decreases later in the season, but these effects were rarely statistically significant. Both sorghum density and intercropping had little effect on total seasonal water use. Dry matter production increased linearly with increasing seasonal water use. Water use efficiencies of dry weight production were increased by increasing sorghum density. Intercropping in dry conditions did not have significant effects on water use efficiencies. Estimates of soil evaporation suggested that the effects of density on water use efficiency could be attributed to reductions in soil evaporation. The effects of density on reproductive yields were governed by two opposing processes: increasing crop density increased water use efficiencies of dry weight production, but decreased the proportions of dry weight allocated to grain. (Author's abstract)
W87-05869

JOINT INFLUENCE OF AIR TEMPERATURE AND SOIL MOISTURE ON CO2 RELEASE BY A SOYBEAN CROP,
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
J. M. N. Da Costa, N. J. Rosenberg, and S. B. Verma.
Agricultural and Forest Meteorology, Vol. 37, No. 3, p 219-227, August 1986. 6 fig, 20 ref. NSF Grants ATM79-01017 and 82-05431.

Descriptors: *Carbon cycle, *Air temperature, *Soil water, *Carbon dioxide, *Soybeans, *Respiration rate, Synergistic effects, Nebraska.

The dependency of soil respiration on temperature and/or soil moisture has been determined in forest soils but not for a whole agronomic crop. In order to provide information for a complete accounting of the carbon balance of such a crop, respiration rates were measured by means of an open-chamber system. The combined effects of air temperature and soil water content on respiration rates in a soybean crop were studied for two seasons at Mead, Nebraska. For soil water potentials above about -1.2 MPa, full crop (aerial portion, roots, and soil) respiration rate (corrected to 20 C) was unaffected by soil water potential. With water potentials <- 1.2 MPa, respiration rates decreased monotonically. Respiration rates increased with increasing temperature. Full-crop respiration rate ranged from 318 to 905 mg CO2/sq m/hr in 1979 and from 362 to 928 mg CO2/sq m/hr in 1980. An interaction between temperature and soil moisture content is evident in the data. Multiple regression indicated that 70-94% of the variation in full crop respiration rates is explained by variations in air temperature and soil water content. (Authors' abstract)
W87-05871

CANOPY TEMPERATURE OF SUGARCANE AS INFLUENCED BY IRRIGATION REGIME,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
K. L. Khera, and B. S. Sandhu.
Agricultural and Forest Meteorology, Vol. 37, No. 3, p 245-258, August 1986. 6 fig, 3 tab, 23 ref.

Descriptors: *Canopy temperature, *Irrigation, *Air temperature, *Sugarcane, *Water stress, India, Soil water.

Recent technological advances in portable infrared thermometers permit rapid, accurate measurement of canopy temperatures in field crops. This development has renewed interest among researchers in the use of foliage temperature as an indicator of plant water status. A field study was conducted in the pre-monsoon dry and hot climatic environment of northern India with differentially irrigated sugarcane to evaluate canopy temperature as an index of water stress. The stressed crop experienced low to moderately high water deficits. During the hotter part of cloudless days, canopy temperature of the unstressed sugarcane was 2-7 C less than that of the stressed crop. The canopy temperature of both stressed and unstressed crops remained 1-12 C cooler than the ambient air temperature. The canopy temperature of the early afternoon hours appeared a more promising index of water than a canopy-minus-air temperature index, possibly due to the effect of turbulent advection from the surrounding hot environment. Regression analysis showed that the variation in average soil water content in the 180-cm profile alone accounted for 73% of the variabion in canopy temperature during the afternoon hours. The contribution of net radiation and air vapor pressure deficit to the predictability of canopy tempterature was small and non-significant. (Authors' abstract)
W87-05872

INTRASPECIFIC VARIABILITY FOR DROUGHT RESISTANCE IN COWPEA,
Texas A and M Univ., College Station. Dept. of Horticultural Sciences.
D. W. Walker, and J. C. Miller.
Scientia Horticulturae SHRTAH, Vol. 29, No. 1/2, p 87-100, June 1986. 5 fig, 4 tab, 21 ref. USAID-CSRS/AID BNF Grant 59-2481-0-5-001-0.

Descriptors: *Irrigation, *Cowpeas, *Drought tolerance, Lubbock, Texas, Agriculture, Genetic variability, Germplasm, Crop yield, Plant growth Productivity, Drought.

Potential drought resistances of 304 cowpea genotypes were determined using plants grown in dryland and irrigated plots near Lubbock, Texas, during a severe drought in 1980. Screening for drought resistance was based on total shoot dry weight 55 and 77 days after planting (DAP). Genotypes were classified as either resistant or susceptible on five criteria: (1) shoot dry weight in dryland plots, 55 and 77 DAP (SDW); (2) percentage reduction in shoot dry weight in dryland plots as

compared to shoot dryweight in irrigated plots (SDW%); (3) rate of growth in dryland plots between 55 and 77 DAP (RATE); (4) percentage reduction in rate of growth between dryland and irrigated plots (RATE%); (5) mean productivity expressed as average performance in both environments (MP). Genotypes classified as resistant or susceptible by percentage reduction criteria, such as SDW% and RATE% tended to perform well in one environment and not in the other. Therefore, identification of drought-resistant germplasm may require screening on the basis of an absolute measurement of performance, such as SDW or RATE, in combination with a percentage reduction criterion, such as SDW% or RATE%. Seven genotypes were classified as drought-resistant and four as drought susceptible by more than three criteria. Improved drought resistance in cowpea via plant breeding appears feasible. (Author's abstract)
W87-05885

RESPONSE OF APRICOT SEEDLING LINES TO WATERLOGGING,
Cairo Univ., Giza (Egypt). Dept. of Horticulture.
M. M. Hassan, A. T. Salem, and M. A. Fayek.
Scientia Horticulturae SHRTAH, Vol. 29, No. 1/2, p 125-130, June 1986. 1 fig, 2 tab, 16 ref.

Descriptors: *Waterlogging, *High water table, *Apricots, *Egypt, *Irrigation, Agriculture, Gas liquid chromatography, Irrigation, Respiration, Roots.

Differences in response to waterlogging and differences in respiration were investigated among the apricot lines grown in Egypt. Fruits from eight trees were picked and the seeds were germinated. Seedlings were used for waterlogging experiments when they were 1 year old and 2 years old. Waterlogging treatment was initiated by closing the drainage system of the plastic containers the seedlings were growing in and adding tap water. Seedlings were removed from the pots three weeks after the waterlogging treatment and washed. Fresh samples of root hairs were kept in known volume vials for 1 h to determine respiration rate using a GLC apparatus. The eight apricot lines demonstrated a wide variation in their response to waterlogging. Line FA-3-6 was far more waterlogging-tolerant than the other lines tested. The water-logging treatment resulted in decreased respiration in roots when compared with nonwaterlogged controls, but to different degrees. The more tolerant the line, the lower the reduction, with 28.1 and 58.3% as extremes. The ability of apricots to tolerate waterlogging seems to be associated with their ability to minimize the reduction in root respiration. (Main-PTT)
W87-05886

ALTERNATIVE APPROACH TO STUDY THE AVOIDANCE OF DUCKWEED (LEMNA GIBBA L. - L. MINOR L. COMPLEX) FROM ARID ZONES,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 2H.
W87-05894

PHOTOSYNTHATE PARTITIONING: A LABILE, ADAPTIVE PHENOMENON IN MICROCYSTIS AERUGINOSA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W87-05895

2J. Erosion and Sedimentation

INITIATION AND FLOW BEHAVIOR OF THE 1980 PINE CREEK AND MUDDY RIVER LAHARS, MOUNT ST. HELENS, WASHINGTON,
Cascades Volcano Observatory, Vancouver, WA.
T. C. Pierson.
Geological Society of America Bulletin BUGMA, Vol. 96, No. 8, p 1056-1069, August 1985. 17 fig, 2 tab, 45 ref.

Descriptors: *Washington, *Mount St. Helens, *Mudflows, *Volcanoes, Pine Creek, Muddy River, Sediment sorting, Flow, Velocity, Sediment transport, Flow discharge, Slurries, Channel flow, Sediment discharge, Sediment concentration, Snowmelt, Erosion rates, Debris.

Two large, high-velocity lahars were triggered by a pyroclastic surge during the first few minutes of the May 18, 1980, eruption of Mount St. Helens. The initial surge cloud evolved progressively by gravity segregation from a gas-mobilized, highly inflated density flow to a dense, water-mobilized, lahar and accompanying ash cloud as it flowed down the east flank of the volcano. The main source of water for the lahar was probably from eroded snow and ice incorporated into the flow from turbulent mixing, but ground water, expelled together with the rock debris by the initiating volcanic explosions, also may have contributed. Peak lahar discharge from the Pine-Muddy fan, upper Smith Creek, and Ape Canyon probably exceeded 250,000 cu m/s initially but decreased exponentially in the downstream direction. Particles up to small boulder size were randomly distributed in the poorly sorted, nonstratified matrix, indicating complete suspension in a fully developed debris-flow slurry: however, much larger clasts were transported as bedload. Two indirect methods for computing peak-flow velocity, previously only tentatively applied to debris flows, were tested for accuracy by comparing computed lahar arrival times with recorded arrival times at Swift Reservoir. (Author's abstract)
W87-05307

RUNOFF AND SOIL LOSS AS INFLUENCED BY TILLAGE AND RESIDUE COVER,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
O. R. Stein, W. H. Neibling, T. J. Logan, and W. C. Moldenhauer.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1527-1531, November-December 1986. 6 tab, 12 ref.

Descriptors: *Runoff, *Erosion, *Tillage effects, *Residue cover, *Soil stability, *Soil erosion, *Simulated rainfall, Transport, Sediments, Plowing, Soil loss, Ridge till, Furrows, Cover, Agriculture.

To gain a better understanding of the interactions between soil detachment, transport capacity, and residue cover, the USDA programmable rainfall simulator was used to erode plots created on established and newly created ridge-till areas of $< 1\%$ slope with and without residue cover. A control of conventional moldboard plow-spring disk was also included. Results showed that for all treatments, ridge sideslope erosion was three to four times greater than total soil loss, suggesting that transport capacity was the limiting factor. For most runs no significant difference in soil loss was measured between ridges of different ages. The presence of residue decreased soil loss to one-sixth or one-seventh on older ridges and to one-half on new ridges. Location of residue was more important than the total amount of residue. Residue placed only on the furrow bottom was as effective in reducing soil loss as residue placed over the entire ridge and furrow, while residue placed only on the sideslope did not reduce soil loss significantly from treatments without residue. (Author's abstract)
W87-05416

MEASUREMENT OF FORCE VS. TIME RELATIONS FOR WATERDROP IMPACT,
M. A. Nearing, J. M. Bradford, and R. D. Holtz.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1532-1536, November-December 1986. 5 fig, 2 tab, 21 ref.

Descriptors: *Rainfall impact, *Erosion, *Soil splash, *Soil erosion, *Precipitation, *Pressure measurement, *Force measurement, Model studies, Prediction, Force distribution, Pressure distribution, Compression waves.

Force vs. time relationships of waterdrop impact are important for understanding the process of erosion caused by soil splash. Waterdrop impact forces were measured for 3.31-, 3.83-, 4.51-, and 5.25-mm diam drops falling from a height of 14.0 m onto piezoelectric transducers with rise times of 2 and 5 micro-sec. Peak forces occurred within 13 to 21 micro-sec of initial contact, ranged from 1.0 to 3.8 N, and decreased to 0.5 N after approximately 100 micro-sec. Average pressures under impact were calculated from the force measurements and an approximation of waterdrop contact area as a function of time and decreased to 100 kPa after 50 micro-sec. The results indicated that the times and magnitudes of the force of impact were poorly predicted from currently used models and that the compressional wave generated in the water upon impact is probably an important parameter in determining the level and time distribution of forces during impact. (Author's abstract)
W87-05417

EFFECT OF SOIL SURFACE SEALING ON SPLASH FROM A SINGLE WATERDROP,
J. M. Bradford, P. A. Remley, J. E. Ferris, and J. B. Santini.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1547-1552, November-December 1986. 1 fig, 6 tab, 21 ref.

Descriptors: *Soil surfaces, *Soil erosion, *Soil sealing, *Rainfall impact, *Soil splash, *Erosion, *Simulated rainfall, *Soil strength, Soil texture, Model studies, Fall-cone strength, Soil crusts.

The erosion process begins when raindrops strike the soil surface. Raindrop energy serves to break down aggregates on the soil surface and detach soil particles from the mass. Detached particles are splashed and fall back to the surface in a more dispersed state. This process continues as rainfall proceeds. Consequently, many physical properties of the surface soil change with time, causing soil splash detachment rate to change with time. Most soil erosion prediction models do not account for surface sealing and soil crusting effects on soil detachment. The objective of this research was to evaluate surface seal formation and subsequent drying effects on amount of soil detached by single waterdrop impact. Twenty soils ranging in texture from sand to clay were tested. Single drop splash and fall-cone strength determinations were made on each soil in an uncrusted condition, in a crusted condition immediately following 1 h of simulated rainfall (63 mm/h), and after 2 to 4 weeks of drying. Splash for the uncrusted condition ranged from 8.9 to 61.0 mg/drop and from 0.8 to 13.7 mg/drop for the crusted condition. Subjecting crusted soils to one drying cycle did not significantly alter splash amount. Splash was correlated with soil strength for both uncrusted and crusted conditions for finer-textured soils; however, for sands and sandy loams additional research is required for soil strength-based splash model for crusted conditions. (Alexander-PTT)
W87-05418

PROBLEM OF CALCULATING LOAD IN WATERCOURSES (ZUM PROBLEM DER FRACHTBERECHNUNG IN FLIESSGEWASSERN),
H. Hellmann.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 4, p 133-139, August 1986. 13 fig, 4 tab, 8 ref.

Descriptors: *Sediment load, *Sediment transport, *Statistics, *Statistical analysis, *Mathematical studies, Sediment carrying capacity, Chemical composition, Statistical methods.

Calculation of sediment loads in watercourses is within the scope of environmental protection which is a problem of immediate interest. A small number of measured values connected with more or less pertinent discharge data is used for annual load computations and applied to trend analysis. By contrast, working groups have been created for solving the problem of sediment load calculation on a large-scale mathematical basis. It was demonstrated that the former method is inadvisable. The problem of how far a great expenditure of statistics

can surmount fundamental difficulties needs further discussion. (Author's abstract)
W87-05455

FORM DRAG RESISTANCE OF TWO-DIMENSIONAL STEPPED STEEP OPEN CHANNELS,
King Faisal Univ., Al-Hasa (Saudi Arabia). Water Studies Inst.
For primary bibliographic entry see Field 8B.
W87-05467

EVALUATION OF THE EROSION IN A VALLEY UNDER DAM BREAK FLOWS (COMMENT EVALUER L'EROSION D'UNE VALLEE SOUS L'ECOULEMENT DE RUPTURE D'UN BARRAGE),
Ecole Polytechnique, Montreal (Quebec).
M. Kenfaoui, and C. Marche.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 4, p 474-484, August 1986. 7 fig, 5 tab, 11 ref.

Descriptors: *Erosion, *Dam failure, *Waves, *Mathematical models, *Model studies, *Sediment transport, Dams, Flow, Movable beds, Fixed beds, Sediments, Steady flow, Mathematical studies, Mathematical equations, Estimating.

Dam-break flows on moveable beds were studied in a laboratory. Significant differences between these wave parameters and values of the same parameters estimated on fixed beds were demonstrated. Moreover, it is shown that under specific flow conditions some sediments transport models for steady flows can be applied to estimate bed erosion for this particular type of flow. (Author's abstract)
W87-05473

DETERMINATION OF SELENIUM IN SEDIMENTS BY FLUORIMETRY WITH 2,3-DIAMINONAPHTHALENE AFTER AN IMPROVED PRETREATMENT BY TELLURIUM COPRECIPITATION,
Nagoya City Environmental Pollution Research Inst. (Japan).
For primary bibliographic entry see Field 5A.
W87-05475

ROLE OF ALKALINE PHOSPHATASE IN THE SEDIMENTS OF VENICE LAGOON ON NUTRIENT REGENERATION,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5C.
W87-05486

MORPHOLOGICAL CHANGES OF THE ARTIFICIAL INLETS OF THE BARDAWIL LAGOON,
Haifa Univ. (Israel). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W87-05490

DETERMINATION OF GENOTOXIC POLYCYCLIC AROMATIC HYDROCARBONS IN A SEDIMENT FROM THE BLACK RIVER (OHIO),
Brigham Young Univ., Provo, UT. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-05499

EFFECTS OF FLOODS ON THE INVERTEBRATE FAUNA OF A LARGE, UNSTABLE BRAIDED RIVER,
Ministry of Agriculture and Fisheries, Wellington (New Zealand). Fisheries Research Div.
For primary bibliographic entry see Field 2E.
W87-05514

LATE HOLOCENE DIATOMS IN LAKE POUKAWA: EFFECTS OF AIRFALL TEPHRA AND CHANGES IN DEPTH,
Victoria Univ., Wellington (New Zealand). Research School of Earth Sciences.
For primary bibliographic entry see Field 2H.
W87-05518

LITTORAL SEDIMENT TRANSPORT AT MANGATAWHIRI SPIT, NEW ZEALAND,
Centre for Resource Management, Canterbury (New Zealand).
G. D. Bridgwater.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 147-151, 1986. 3 fig, 12 ref.

Descriptors: *Littoral drift, *Sediment transport, *Beach erosion, *Erosion control, *Mangatawhiri Spit, New Zealand, Beaches, Sand, Sediments, Transport, Drift.

Beach sand characteristics were used to determine littoral drift along Mangatawhiri Spit, New Zealand. These show there is a bi-directional movement of sediment away from the approximate center of the spit; that spit orientation is not a reliable indicator of littoral drift direction along Mangatawhiri Spit; and that present remedial works for erosion control at Mangatawhiri Spit will only be partially effective during an erosion phase. (Author's abstract)
W87-05519

SLOPE INDICATOR MEASUREMENTS OF SUBSURFACE MOVEMENT IN GULLY WALLS,
Royal Tropical Inst., Amsterdam (Netherlands).
P. van der Poel, R. G. Spomer, and R. F. Piest.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 982-987, July-August 1986. 6 fig, 3 tab, 9 ref.

Descriptors: *Slope indicator tubes, *Gully erosion, *Slope gages, *Channel erosion, *Soil movement, *Bank erosion, *Runoff, Flood peak, Bank stabilization, Deflection, Erosion, Gullies, Banks, Slopes.

Slope indicator access tubes were installed in gully banks along an actively eroding channel and upstream of an actively advancing gully headcut in western Iowa. Deflection of these aluminum access tubes due to soil movement was measured with a slope indicator probe capable of sensing small horizontal displacement. Surface soil movement adjacent to the channel was toward the channel; deflections of the tubes at greater depths were generally toward the channel and indicated slab or toppling failure. Bank failure was related to high peak flows and passing channel scarps that decreased bank stability, especially during spring runoff. All recorded bank failures showed greatest displacement at the surface with most of the movement occurring above a depth of 3 to 4 m (10 to 13 ft). At distances of 6 and 10 m (19 and 33 ft) from the channel most soil movement occurred at depths of 3 to 7 m (10 to 24 ft) rather than at the surface. All failure depths were less than the gully depth, while soil movement exceeded gully depth. This indicated that access tubes should be installed as much as 5 m (16 ft) below the channel bottom to record complete movement. Results indicate that this procedure can be used to quantify bank conditions leading to failure. (Author's abstract)
W87-05524

CHEMICAL AND PHYSICAL CHARACTERISTICS OF WINDBLOWN SEDIMENT: I. QUANTITIES AND PHYSICAL CHARACTERISTICS,
Agricultural Research Service, Big Spring, TX.
T. M. Zobeck, and D. W. Fryrear.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1032-1036, July-August 1986. 3 fig, 4 tab, 21 ref.

Descriptors: *Sediments, *Dust storms, *Wind erosion, Sand, Silt, Clays, Dusts, Soil surfaces, Storms, Erosion, Big Spring, Texas.

Between January and July of 1984, 31 dust storms were recorded in Big Spring, TX and samples from 10 were sufficiently large for soil aggregate and particle analysis. Samples of airborne wind eroded material were collected from seven heights between 0.15 and 4 m above the soil surface. Changes in total quantity of solids, and the percentages of sand, silt and clay with height fit log-log distributions with correlation coefficients ranging from 0.90 to 0.94. The percent of silt and clay increased with height and the percent of sand decreased. However, as the sample size increased, the percent as sand increased and percent as silt and clay decreased. In addition, the mean diameter (MD) of individual particles and aggregates decreased with increasing height. The MD of particles in dispersed samples was 40 to 45% the diameter of undispersed samples (aggregates) at the same height or date. The largest samples were the product of high wind speeds and long storm durations and the sample size and particle distribution reflected the high wind energy levels of the most severe storms. (See also W87-05532) (Author's abstract)
W87-05531

CHEMICAL AND PHYSICAL CHARACTERISTICS OF WINDBLOWN SEDIMENT: II. CHEMICAL CHARACTERISTICS AND TOTAL SOIL AND NUTRIENT DISCHARGE,
Agricultural Research Service, Big Spring, TX.
T. M. Zobeck, and D. W. Fryrear.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1037-1041, July-August 1986. 8 tab, 12 ref.

Descriptors: *Sediments, *Wind erosion, *Dust storms, *Nutrients removal, *Soil erosion, Organic matter, Storm intensity, Soil surfaces, Ions, Nutrients, Winds, Dusts, Erosion, Storms, Big Spring, Texas.

The erosion of soil particles by wind produced dust with an enrichment ratio varying from 1 to 3 for Na, K, Ca, Mg, cation exchange capacity, and organic matter. While the annual average total loss was less than total nutrient content of the soil surface, the cumulative loss of these essential nutrients will tend to degrade the soil over a period of several years. The quantity of soil carried by wind decreased with height above the soil surface, but the concentration of Na, K, Ca, Mg, cation exchange capacity, and organic matter increased with height. Although the total amount of soil eroded increased with storm intensity, the relation between storm intensity and nutrient content was not well defined. (See also W87-05531) (Author's abstract)
W87-05532

LOCAL SCOUR CAUSED BY SUBMERGED WALL JETS,
Liverpool Univ. (England). Dept. of Civil Engineering.
K. H. M. Ali, and S. Y. Lim.
Proceedings of Institutional Civil Engineers PICEAT, Vol. 81, Part 2, p 607-645, December 1986. 20 fig, 17 ref.

Descriptors: *Model studies, *Hydrodynamics, *Channel erosion, *Scour, *Jets, *Hydraulic models, *Channel scour, Water depth, Shear stress, Mathematical analysis, Water currents, Boundary layers, Velocity, Estimating, Comparison studies.

Clear water scour results are given for localized scour caused by two- and three-dimensional turbulent wall jets. Experiments were conducted with, in most cases, shallow tailwater depths. They showed conclusively that the tailwater depth profoundly affected the scouring process. Theoretical calculations of the maximum depth of a scour hole were made. Velocity distributions associated with the development of a scour hole were obtained. Rossinskii's analysis was used to determine the theoretical velocity distributions for a two-dimensional scour hole. Analysis was used also to obtain the boundary shear stress distribution in a scour hole. A simple method of estimating the boundary shear stress was developed and compared with that obtained using turbulent boundary layer theory. (Author's abstract)
W87-05569

EPISODES OF VERTICAL ACCRETION AND CATASTROPHIC STRIPPING: A MODEL OF

DISEQUILIBRIUM FLOOD-PLAIN DEVELOPMENT,
Wollongong Univ. (Australia). Dept. of Geography.
G. C. Nanson.
Geological Society of America Bulletin BUGMA, Vol. 97, No. 12, p 1467-1475, December 1986. 10 fig, 1 tab, 51 ref.

Descriptors: *Floods, *Flood plains, *Flow channels, *Accretion, *Channel accretion, *Deposition, *Erosion, *Sediments, *Sediment transport, *Rivers, *Model studies, Sediment-carrying capacity, Aggradation, Alluvium, Australia, Levees, Channel flow, Channels, Flood channels, Scour, Channel scour.

Flood plains formed episodically by vertical accretion along high-energy, laterally stable channels in southeastern Australia are described. Overbank deposition gradually builds a flood plain of fine-textured alluvium over a period of hundreds or thousands of years, following which catastrophic erosion by a single large flood, or a series of moderate floods, strips the flood plain to a basal lag deposit from which it slowly reforms. This periodic destruction appears due to the progressive development of large levee banks and flood-plain surfaces of highly variable relief. As the levees and flood plain grow, overbank flow is gradually displaced from the broad flood plain into the main channel and flood-plain backchannels, with a resulting concentration of erosional energy. Eventually, high flows greatly exceed erosional thresholds, and wholesale scour of the channel boundary and flood plain occurs. Vertical-accretion flood plains at different stages of development result in a wide range of bankfull recurrence intervals, even along the same river. Some of these flood plains are so infrequently flooded that they can be mistaken for terraces formed under a prior flow regime. The almost random but catastrophic nature of this flood-plain erosion means that sediment supply and transport are highly variable and probably impossible to predict. This model of flood-plain formation is seen as only part of a continuum of alluvial environments ranging from vestigal, coarse-grained, traction-load flood plains along high-energy rivers in narrow gorges to extensive low-gradient flood plains in which alluvial stratigraphy is dominated by fine-grained overbank deposition. (Author's abstract)
W87-05601

SPRING-RELATED CARBONATE ROCKS, MG CLAYS, AND ASSOCIATED MINERALS IN PLIOCENE DEPOSITS OF THE AMARGOSA DESERT, NEVADA AND CALIFORNIA,
Illinois Univ. at Urbana-Champaign. Dept. of Geology.
R. L. Hay, R. E. Pexton, T. T. Teague, and T. K. Kyser.
Geological Society of America Bulletin BUGMA, Vol. 97, No. 12, p 1488-1503, December 1986. 7 fig, 2 tab, 51 ref. NSF Grant EAR 78-01776.

Descriptors: *Sediments, *Sedimentation, *Diagenesis, *Chemical composition, *Chemical precipitation, *Isotope studies, *Pliocene deposits, *Carbonate rocks, Magnesium compounds, *Clays, *Minerals, Clay minerals, Amargosa Desert, Nevada, California, Basins, Playas, Marshes, Ponds, Flood plains, Dating, Stratigraphy, Paleohydrology, Dolomite, Limestone.

The Amargosa Desert of Nevada-California is a spring-fed structural basin containing large amounts of Pliocene carbonate rocks and Mg clays deposited in playas, marshland, ponds, and flood plains. The nature and environments of chemical sedimentation and diagenesis in the stratigraphic unit containing the large Mg-clay deposits was studied. Pliocene basin-filled deposits dated at 2.4 t0 3.2 Ma were subdivided into three lithofacies, designated Tpa, Tld, and Tpl. Tpa is chiefly limestone and was deposited in marshland and ponds. Tld consists chiefly of limestone and mont-morillonite claystone that were deposited in varied environments, including ponds and flood plains. Tpl is almost entirely Mg clays, limestone, and dolomite, which were deposited in playas and associated marshland. The paleohydrology was inferred from the distribution, composition and morphology of chemically deposited sediments. Isotopic data from authentic minerals in the different facies provided a basis for estimating the relative evaporative concentration of water in the different environments. (Wood-PTT)
W87-05602

MINERALIZATION AND SORPTION OF P-NITROPHENOL IN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5B.
W87-05654

EFFECTS OF SAMPLES STORAGE ON A COPPER-SPIKED FRESHWATER SEDIMENT,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5A.
W87-05657

PROCEEDINGS OF THE FOURTH FEDERAL INTERAGENCY SEDIMENTATION CONFERENCE.
Interagency Advisory Committee on Water Data, Reston, VA. Subcommittee on Sedimentation.
March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. 489 p.

Descriptors: *Sedimentation, *Conferences, Instrumentation, Erosion control, Sediment control, Sediment yield, Sediment transport.

These proceedings of the Fourth Federal Interagency Sedimentation Conference contain 102 technical papers, in two volumes, which were submitted by representatives of 11 Federal agencies for presentation at the conference. The papers are organized under eight general topics, four of which are discussed in this, Volume I. These are: instrumentation, erosion and sediment control, sediment yield and sources, and sediment transport and deposition. (See also W87-05741 through W87-05791) (Lantz-PTT)
W87-05740

SEDIGRAPH AS AN ALTERNATIVE METHOD TO THE PIPET,
Geological Survey, Iowa City, IA. Water Resources Div.
O. G. Lara, and W. J. Matthes.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-1 to 1-12, 5 fig, 5 tab, 8 ref.

Descriptors: *Sediments, *Particle size, *Sedigraphy, *Pipets, Measuring instruments, Sediment load, Particulate matter, Training.

The SediGraph and the pipet methods of particle-size analysis are compared using the results from replicate runs of reference sediment samples prepared by the U.S. Geological Survey. Tests were designed to provide information on the operational characteristics of the SediGraph method including operator training needed, time required to make a complete analysis, and reproducibility of results under varying conditions. The results indicate that the SediGraph method takes 50% less time to complete an analysis than does the pipet method. The training of qualified operators for the SediGraph method is less demanding and not as critical as for the pipet method. Results of comparable accuracy also were obtained using varying sediment concentrations and different instrument cells. Agreement between the SediGraph and pipet results is good for samples having large percentages of fine material (50-60% finer than one micrometer). The agreement is acceptable for samples having relatively uniform distribution of particle size. For samples having a large percentage of coarse material (65-75% coarser than 10 micrometers) the SediGraph method results indicate finer particle-size distribution than do the pipet-method results. Acceptance of an alternative method to the pipet method depends on convenience, availability of qualified operators, efficiency, reproducibility, and comparability of results with the pipet method. This study shows that the SediGraph method fulfills these criteria adequately. The SediGraph method could be adopted by the U.S. Geological Survey as one of the standard methods for particle-size analysis of sediment. (See also W87-05740) (Author's abstract)
W87-05741

DEVELOPMENT OF A TRACE-METAL P61 POINT-INTEGRATING SAMPLER,
Army Engineer District, St. Paul, MN.
D. A. Benson.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-13 to 1-19, 3 fig.

Descriptors: *Trace metals, *Water quality, *Sediments, *Point-integrating sampler, Pollutant identification, Measuring instruments, Metal sampler, Sampling, Water sampling.

Metal contamination of water samples by the use of a metal sampler is a concern of sampler fabricators and users alike. The P61 trace-metal point-integrating sampler distributed by the Federal Interagency Sedimentation Project addresses the problem by lining the water passageways with Teflon to reduce the contamination. However, the water sample does hav to pass through a stainless-steel valve. The project installed a plastic valve and valve block in a P61 point-integrating sediment sampler. A test was performed using two P61 samplers held together side by side, submersed in a tank of water. One sampler had a plastic valve and valve block, and the other had the presently used a sleeved-bronze valve block and stainless-steel valve. At regular intervals, the concentration was increased by 200 parts per million (ppm) of a particular size of sediment. The tank water was agitated and a sample drawn from each sampler. This procedure was continued until either sampler failed. Three sizes of graded sediment were chosen, that were capable of passing between the clearance tolerance of the valve and the valve block. In testing the three sizes of sediment, the sampler with the sleeved-bronze valve block failed first. Beside the advantage of being plastic, the trace-metal device appears to work better mechanically when dealing with sediment 100 micrometers or smaller. (See also W87-05740) (Author's abstract)
W87-05742

EFFECTS OF NOZZLE ORIENTATION ON SEDIMENT SAMPLING,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W87-05743

CONTINUOUS MEASUREMENT OF SUSPENDED-SEDIMENT CONCENTRATION,
Geological Survey, Minneapolis, MN.
J. V. Skinner, J. P. Beverage, and G. L. Goddard.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-29 to 1-39, 3 fig, 1 tab, 3 ref.

Descriptors: *Suspended sediments, *Sediment sampling, *Water quality, *Madison, *Wisconsin, *Measuring instruments, River water, Field tests, Conductivity, Temperature, Sampling pumps, Sediment concentrations.

A field instrument that collects sediment-concentration data is being tested at a gaging station on Willow Creek in Madison, Wisconsin. River water is pumped through a U-shaped tube that vibrates continuously. The tube's vibrational period is a function of river water density which, in turn, is related to suspended sediment concentration. At 5-minute intervals, data on vibrational period, water conductivity, and water temperature are recorded. Every 4 hours, the most current data set is automatically transmitted by telephone to a computer that stores the information for processing at a later time. During periods of high flow, the data-collec-

tion procedure is occasionally interrupted to take reference readings. The pump is stopped, the U-tube is manually filled with distilled water, and then the vibrational period is recorded. With these reference readings, the data sets can be verified and, if necessary, correction factors can be applied. The U-tube and the data collection devices have operated with a high-degree of reliability. However, sampling pump failures have hampered the process of evaluatingg the U-tube's accuracy. Data collected early in the test program indicated a probable measurement error of about + or - 200 milligrams/L for sediment concentration. Later, the pump was modified to increase and stabilize its discharge. Data from the last storm of record showed the probable measurement error decreased to about + or - mg/L. (See also W87-05740) (Author's abstract)
W87-05744

INSTRUMENTS FOR MEASURING SUSPENDED SEDIMENT,
Geological Survey, NSTL Station, MS.
J. H. Ficken.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-40 to 1-50, 5 fig, 2 ref.

Descriptors: *Measuring instruements, *Suspended sediments, *Sediment testing, Performance evaluation, Field tests, Particle size, X-Rays, Ultrasonics, Infrared light, Inertia, Cost analysis.

In recent years, a high priority has been placed on advancing the technology for determining the concentration and size distribution of suspended sediment, both in the field and laboratory. The U.S. Geological Survey's Instrument Development Laboratory is investigating the application of off-the-shelf commercial instrumentation to satisfy the needs and requirements of the sediment community. These activities include the support of testing and evaluation in the field and laboratory. Instruments utilizing basic phenomena such as x-rays, ultrasonics, infrared and other light, and inertial characteristics are evaluated, and the results presented here. Some of these are: the X-Ray Particle Size Analyzer, the Vibrating U-Tube Fluid-density Gage, and the Ultrasonic Suspended-Solids meter. Existing equipment is being updated and/or redesigned to incorporate technical improvements. The major further emphasis here, is on the quality of collected data and the reduction of cost in acquiring the data. (See also W87-05740) (Author's abstract)
W87-05745

SMALL WATERSHED AUTOMATIC WATER QUALITY SAMPLER,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
K. G. Renard, J. R. Simanton, and C. E. Fancher.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-51 to 1-58, 4 fig, 5 ref.

Descriptors: *Water quality, *Measuring instruments, *Watersheds, *Sediments, Water sampling, Automation, Water quality control, Performance evaluation.

A total-load, automatic sediment sampler has been developed for use with pre-calibrated runoff-measuring devices in association with small watershed water quality research. The system collects individual samples periodically during a runoff event at the exit of the precalibrated measuring flume, and consists of two parts, the sampler and the sample storage mechanism. The sampler is a vertical slot which traverses across the flume exit on a horizontal rail. The traverse speed of the slot is controlled by the design criteria of the sample storage mechanism. On early models of the unit, sample storage was a revolving table with a capacity of 18 two-liter bottles. For these early units, the traverse speed was made variable and regulated by the flow depth and, in turn, by the discharge rate. Subsequent designs have replaced the revolving table with a continuous chain to which the sample bottles are attached. In this design, the slot makes multiple traverses until a preset sample size is obtained. Following filling, the bottle is lifted from the position where the discharge from the slot fills the bottle. Each traverse (bottle filling) is recorded on the water stage recorder. System power is obtained from a 12-volt battery charged by a photovoltaic cell. This allows sampler operation in remote areas where conventional electrical power is not economically available. (See also W87-05740) (Author's abstract)
W87-05746

INNOVATIVE TECHNIQUES FOR COLLECTING HYDROLOGIC DATA,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2E.
W87-05747

SUSPENDED SEDIMENT MONITORED BY SATELLITE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
F. R. Schiebe, and J. C. Ritchie.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-70 to 1-78, 6 fig, 1 tab, 6 ref.

Descriptors: *Suspended sediments, *Sediments, *Water quality, *Monitoring, *Satellite technology, Remote sensing, *Measuring instruments, Data acquisition, Data interpretation, LANDSAT, Spectroradiometer.

Research concerning the remote sensing of suspended sediment in surface waters has been carried out in three stages: (1) laboratory measurements were made under carefully controlled conditions using a large optical tank facility where sediments collected from two different impoundments were suspended, (2) hand held spectroradiometer measurements were made at 25 nanometer intervals in the visible and near infrared spectrum over impounded water containing various concentrations of suspended sediments, and (3) data obtained from over thirty environmental satellite (LANDSAT) scenes over a period of four years were analyzed, and correlated with ground truth data. The laboratory and hand held radiometer results show that reflectance in the near infrared region, 700-950 nanometers, is nearly proportional to suspended inorganic sediment concentrations. The LANDSAT data show definite but lower correlation with suspended sediments at the same near infrared wavelengths with the added benefit of providing a synoptic image. (See also W87-05740) (Author's abstract)
W87-05748

RATING EROSION SUSCEPTIBILITY,
Bureau of Land Management, Phoenix, AZ. Phoenix District Office.
M. E. van der Puy.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 2-1 to 2-7, 4 fig, 1 tab, 5 ref.

Descriptors: *Erosion, *Soil erosion, *Rating systems, Erosion rates, Wind erosion, Soil erosion, Universal Soil Loss Equation, Watersheds, Sediment yield.

An Erosion Susceptibility Rating System was devised to provide land managers with an adequate and meaningful evaluation of current erosion conditions and erosion hazards as related to specific large scale resource management programs. Using existing soil survey data, combined wind and water erosion hazard ratings can be developed to compare the relative effects of management alternatives on soil erosion. This method is particularly useful in comparing alternative routes for linear-type disturbances such as transmission line routes, gas pipelines and off-road vehicle races. Erosion condition classification data is also available on 1545 million acres of land administered by the Bureau of Land Management. By coupling erosion condition classifications with combined erosion hazard ratings, a dual component Erosion Susceptibility Rating System can be developed for particular watersheds. The effect of large scale resource management programs on particular watersheds can then be assessed. Current approaches to assessing watershed immpacts usually involve the Uniform Soil Loss Equation, Pacific Southwest Inter-agency Committee, or other methods which provide quantitative estimates of on-site erosion or sediment yield. In addition to the inherent weaknesses of these methods, the final product is usually a number which is meaningless to the decision maker. (See also W87-05740) (Lantz-PTT)
W87-05750

SEDIMENT TRANSPORT IN THE BLUE CREEK WATERSHED,
Environmental Protection Agency, Chicago, IL. Region V.
T. E. Davenport.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 2-8 to 2-17, 1 fig, 3 tab, 18 ref.

Descriptors: *Sediment transport, *Blue Creek, *Illinois, *Watersheds, *Monitoring, Resource management systems, Data acquisition, Data interpretation, Water quality, Sediment load, Erosion, Runoff.

Illinois Environmental Protection Agency in cooperation with various U.S. Department of Agriculture Agencies, evaluated the water quality impacts of resource management systems (RMSs) implemented under the Agricultural Conservation Program (ACP) Special Water Quality Project in the Blue Creek Watershed. The monitoring program was designed to link water quality to what was happening on the land area. Sediment data was temporally stratified to account for land management and historic precipitation patatern. Then to determine the effectiveness of the RMS, implemented, sediment data were stratified by precipitation category so as to characterize the principal detachment mechanism. Based on the variable source concept and the findings of the monitoring effort within the Blue Creek, the following land treatment recommendations are made. RMSs must be implemented to slow runoff velocity and volume at the edge of fields to reduce sediment carrying capacity of snowmelt runoff. A water quality land treatment zone must be established where only those fields immediately adjacent to the stream network are treated so as to slow runoff velocity and volume (water management). To ensure water quality benefits land treatment within this zone must also reduce soil erosion. A multiple purpose RMS must be implemented for the offsite and onsite benefits of water management and erosion control. Conservative practices such as conservation tillage, contour farming, grassed waterways, diversions, sediment basins, and terraces have this effect. (See also W87-05740) (Lantz-PTT)
W87-05751

HISTORICAL BLM MANCOS SHALE MANAGEMENT IN NW, CO.,
Bureau of Land Management, Meeker, CO.
For primary bibliographic entry see Field 5G.
W87-05752

SEDIMENT AND FORESTRY PRACTICES IN THE SOUTH,
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
S. J. Ursic.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 2-28 to 2-37, 4 tab, 35 ref.

Descriptors: *Sediment concentrations, *Sediment control, *Annual distribution, *Pine trees, *Soil types, *Water quality control, Catchment areas, *Forest watersheds, *Forest management, Sediment transport.

An average annual base rate for sediment concentrations in flows from small catchments of undisturbed southern pine is applicable to a wide diversity of Southern soils and topography. Catchment studies of forestry practices have determined the range and duration of changes in sediment concentrations, and allow comparisons of alternatives. Planting pine can decrease sediment concentrations to the base rate in less than 5 years. Pine forests can be harvested with minimum, short-lived sediment impacts, but where channels are nonresistant, flow increases after harvesting can impair downstream water quality. Intensive mechanical site preparation can result in short-term sediment characteristics approaching those for cultivated lands. This information can help define 'best management practices,' the approach currently advocated to protect the quality of southern surface waters, and can help meet the mandates of the National Forest Management Act. (See also W87-05740) (Author's abstract)
W87-05753

EVALUATION OF EMBANKMENT DAMAGE AND PROTECTION,
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 4D.
W87-05754

CHANAGES IN ALLUVIAL DEPOSITS, UPPER GRAND CANYON,
Geological Survey, Tucson, AZ.
J. C. Schmidt.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 2-48 to 2-57, 4 fig, 2 tab, 9 ref.

Descriptors: *Alluvial deposits, *Grand Canyon, *Sands, *Colorado River, *Colorado, *Sediment transport, Banks, Channels, Channel flow, Flow profile.

Sandy alluvial deposits along the Colorado River in the Grand Canyon are an important environmental resource, particularly as campsites for the approximately 15,000 persons who each year raft the river through Grand Canyon National Park. Three types of deposits associated with major zones of flow separation below channel constrictions can be distinguished - deposits near the point of separation of downstream flow from the channel banks, deposits in the center of the principal eddy formed by the flow separation, and deposits near the point of reattachment of downstream flow to the banks. A fourth type, the upper-pool deposit, is associated with eddies and low-velocity areas above many constrictions. Analysis of large-scale topographic changes in these deposits from 1973 to 1984 along 20 river miles shows that (1) the location of deposits that are used as major campsites has not changed, and (2) several smaller deposits have apparently been eroded. Most deposits that have apparently eroded are reattachment deposits; however, most major campsites are separation deposits. (See also W87-05740) (Author's abstract)
W87-05755

ROLE OF LARGE EVENTS IN AVERAGE SOIL LOSS,
Agricultural Research Service, Columbia, MO.
A. T. Hjelmfelt, L. A. Kramer, and R. G. Spomer.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-1 to 3-9, 4 fig, 2 tab, 4 ref.

Descriptors: *Soil loss, *Soil erosion, *Sediment transport, *Sediment yield, *Kingdom City, *Missouri, *Treynor, *Iowa, Corn, History, Erosion, Model studies.

Long-term records of soil loss from plots and sediment yield from fields cropped to corn were evaluated to assess the significance of large events in establishing average annual sediment production. At Kingdom City, Missouri, the 37 year average annual soil loss was 8 mg/ha. Only nine of those 37 years showed soil loss greater than average. On an individual event basis, 4% if the events accounted for 50% of the total soil loss. Treynor, Iowa, the 18-yr average sediment yield was 26 mg/ha. Only four years exhibited sediment yield greater than the average. Three percent of the events accounted for more than 50% of the total erosion. (See also W87-05740) (Author's abstract)
W87-05756

SEDIMENT REDISTRIBUTION BY RAINDROP IMPACT,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
M. J. M. Romkens, and J. Y. Wang.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-10 to 3-18, 5 fig, 1 tab, 12 ref.

Descriptors: *Sediment transport, *Sediment yield, *Soil loss, *Soil erosion, *Rainfall impact, Rainfall, Erosion, Mathematical studies, Mathematical analysis.

Soil loss during rainfall from upland areas is either estimated from soil erosion prediction equations or is measured at runoff gaging stations in downslope drainage channels or at discharge points on the field. Considerable soil movement that is not accounted for by these estimation procedures, however, may take place within a field. The need to improve the understanding of soil erosion processes and predictions requires more detailed, preferably mathematical, descriptions and evaluations of soil redistribution within an area. This paper summarizes recent progress in evaluating soil redistribution and movement using measured changes in surface elevations following the application of rain. Sediment redistribution by rainfall is discussed in relation to changes in roughness following the application of several consecutive rainstorms. An overview of different roughness parameters is given and their values are computed and compared for a number of transects. Different microrelief measuring devices are discussed. Changes in roughness are described in terms of an exponential decaying function of the cumulative rainfall. (See also W87-05740) (Lantz-PTT)
W87-05757

SEDIMENT YIELD FROM SMALL AND MEDIUM WATERSHEDS,
Soil Conservation Service, Washington, DC.
C. D. Clarke, and P. G. Waldo.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-19 to 3-28, 3 fig, 21 ref.

Descriptors: *Sediment yield, *Watersheds, *Slope morphology, *Sediment transport, *Overland flow, Soil erosion, Channels, Universal Soil Loss equation, Sediment Delivery Ratios, Mathematical analysis, Drainage.

Hillside slope morphology and surface roughness affect the transport efficiency of overland flow. The slope configuration method quantifies the effects of downslope changes and predicts average annual erosion and sediment yield to low order channels within fields. A modification of the complex slope version of the Universal Soil Loss Equation (USLE) estimates sheet and rill erosion. Transport efficiency, or Sediment Delivery Ratio (SDR), is computed from representative overland profiles. The method predicts sediment yields from sheet and rill erosion in small watersheds (<10 sq mi). Sediment transport efficiency in medium-sized (0.1 to 1,000 sq mi) watersheds depends both on hillside morphology and on characteristics of the stream channel system. Methods for estimating channel transport efficiency vary, depending on data available and the degree or accuracy desired. Direct methods require stream gage or reservoir survey data. The accounting method uses field and photogrammetric mapping techniques to identify and quantify the effects of sediment traps or sinks. A predictive method depends on the relationship established between SDR and drainage area. The methods apply to a variety of small and medium-sized watersheds. (See also W87-05740) (Author's abstract)
W87-05758

EPHEMERAL GULLY EROSION,
Agricultural Research Service, Ames, IA.
J. M. Laflen, D. A. Watson, and T. G. Franti.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-29 to 3-37, 2 tab, 11 ref.

Descriptors: *Gully erosion, *Channel flow, *Tillage, *Ephemeral gullies, *Soil erosion, Universal Soil Loss Equation, Channel flow, Theoretical analysis, Soil erosion, Channel erosion, Gullies.

Ephemeral gully erosion is a form of erosion caused by concentrated flow in small channels that are routinely destroyed by tillage. Erosion in these channels is not predicted by the Universal Soil Loss Equation and isn ot accounted for in current soil loss assessment programs. Ephemeral gully erosion can be very significant, and its magnitude depends on many factors. Ephemeral gully erosion can exceed 25% of the erosion predicted by the Universal Soil Loss Equation, and, because it is a flow related phenomena, tends to be much greater in areas where surface runoff is great. While the ability to predict erosion in ephemeral gullies have not been adequately tested, a few theoretical and empirical approaches have been advanced. Two critical needs for improving predictions of ephemeral gully erosion rates are better values for the process coefficients for a range of soil conditions and a better understanding of the erosive process itself. There is an array of practices available that may be used on most cropland to control the formation of, and the erosion in, ephemeral gullies. (See also W87-05740) (Author's abstract)
W87-05759

DRAINAGE DENSITY VERSUS RUNOFF AND SEDIMENT YIELD,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2E.
W87-05760

SEDIMENT YIELD METHODS USED IN THE CORPS OF ENGINEERS,
Army Engineer District, St. Louis, MO.
G. R. Dyhouse.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-45 to 3-53, 20 ref.

Descriptors: *Sediment yield, *Sediment load, *Data acquisition, Discharge, Mathematical studies, Model studies, Hydrologic models, Reservoir silting, Empirical analysis, Soil Loss Equation, Erosion.

The primary methods employed by the Corps of Engineers to compute sediment yield have changed but slightly over the past decade. The use of sediment load curves, either measured or developed predictively, integrated with discharge-duration curves predominates. The development and application of hydrologic and sediment transport models has allowed this technique to be used for studies with essentially no sediment or discharge data. Reservoir deposition measurements are used primarily as a comparison with the sediment load curve method, or to transfer yield information to ungaged areas. Soil loss equations and other empirical techniques see limited application by the Corps; being used mainly to estimate yield for reconnaissance level reports, to estimate sediment-impact of an alternative, or to develop a watershed sediment budget. (See also W87-05740) (Author's abstract)
W87-05761

SEDIMENT STORAGE AND DELIVERY - EASTERN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
K. L. Clarkin, M. D. Harvey, A. Elkin, and S. C.

McIntyre.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-54 to 3-62, 6 fig, 2 tab, 19 ref.

Descriptors: *Sediment transport, *Sediment storage, *Colorado, *Kiowa Creek, Storage basins, Mathematical studies, Cesium radioisotopes, Watershed budgets, Reservoirs, Sediment budget.

Differences in sediment delivery ratio at four small reservoirs in the Kiowa Creek watershed, Colorado, are related to basin storage capacity, measured as percent of total basin area in depositional sites. Storage capacity depends both on topography and the degree of integration of the incised channel network. In semi-arid areas, drainage network continuity, and therefore area available to store sediment, may change over time as a basin undergoes a cycle of high sediment production, storage and flushing. The results of this study illustrate the fact that delivery ratios estimated from empirical relationships with drainage area or channel or watershed slope can result in gross over- or underdesign of reservoir sediment pools. Watershed sediment budgets in conjunction with results from Cs-137 profiles in stored sediments suggest that long-term average delivery ratios have increased in the K41 basin, where drainage network degradation and concurrent loss of storage capacity have occurred since 1955. In the B9 subbasins, where loss of basin storage capacity has been negligible, delivery ratios appear to have remained approximately constant. (See also W87-05740) (Lantz-PTT)
W87-05762

SEDIMENT YIELD AND RUNOFF AFTER TIMBER HARVEST,
Bureau of Land Management, Missoula, MT.
V. A. Ciliberti.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-64 to 3-72, 5 fig, 2 tab, 9 ref.

Descriptors: *Sediment yield, *Soil erosion, *Runoff, *Forestry, *Forest management, Sedimentary rates, Annual precipitation, Runoff, Rainfall-runoff relationships, Model studies, Sediment discharge, Sediment transport, Clearcutting.

Timber management activities in a hard (metamorphosed) sedimentary rock basins from 1978 to 1982 resulted in 8% of the basin being 'Equivalent Clearcut Status (i.e., that portion of vegetation removal, per unit area, which responds hydrologically the same as one acre of clearcut). Annual sediment production of 1.4 to 4.5 tons/sq mi/yr approximates the 5.2 tons/sq mi/yr provided by the FS model 'Guide for Prediciting Sediment Yields from Forested Watersheds'. Calculated annual runoff, based on the Vegetation Manipulation Guidelines using average annual isohyetal precipitation data is within 5.5% of measured runoff. The following conclusions were derived from data generated by this analysis: (1) Increase in runoff, traceable to vegetation removal, has not reached the detection limit (the model establishes that removal of up to 15% of crown cover has no effect upon water yield); (2) The runoff-precipitation relationship as defined by the model is valid on this type of basin (rate of runoff and annual runoff data support this conclusion); (3) The sediment model's estimate of 5.2 tons/sq mi/yr for total sediment production is basically valid for this type of basin; and (4) Sediment production approaches the natural erosion rate. Annual sediment production and channel condition support this conclusion. (See also W87-05740) (Lantz-PTT)
W87-05763

RIVER SEDIMENT BUDGET,
Army Engineer District, Sacramento, CA.
E. F. Sing.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 3-73 to 3-82, 2 fig, 4 tab, 7 ref.

Descriptors: *River sediments, *Sediment budget, *Sediment transport, *Sacramento River, *California, Sediment distribution, Erosion, Bank protection, Dredging, Channels.

Sediment budgets can be used as a simple but useful tool to identify and quantify sediment inflows and outflows to a river system and aid in evaluating the disposition of sediments within the system itself. In essence, it is a 'book-keeping' system. The sensitivity of various elements of the budget to changes in other elements can be readily evaluated. A case study is presented of the impacts of a proposed comprehensive bank protection program on the upper portion of the Sacramento River in Northern California. Evaluation of the budgets for this study revealed that bank eroded material contributes about 60%, or 7.5 million tons/yr, or the total sediment inflow of 12.7 million tons/yr into the river system. Much of this eroded material is carried down through the river system and deposits into the flood control bypasses and downstream navigation channels. This material must be removed if the effectiveness of the flood control system and the navigation channels are to be maintained. Assuming that the proposed bank protection project is 100% effective in reducing the bank erosion rate, it is estimated the amount of material passing Sacramento will be reduced one million tons/yr resulting in a significant reduction in the amount of dredging required in the downstream ship channels and flood control bypasses. (See also W87-05740) (Lantz-PTT)
W87-05764

SEDIMENT CONCENTRATION AND CHANNEL MORPHOLOGY,
Cascades Volcano Observatory, Vancouver, WA.
R. J. Janda, and D. F. Meyer.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 232-241, 5 fig, 2 tab, 27 ref.

Descriptors: *Sediment concentration, *Channel morphology, *North Fork, *Mt. St. Helens, *Volcanoes, *Toutle River, *Washington, Debris basins, Sediment transport, Channels, Sediment yield, Sand, Lahars.

Debris flows and hyperconcentrated streamflows in the North Fork and mainstem of the Toutle River leave a channel narrower, straighter, and with finer bed material grain size due to the yield strength, the low turbulence, and the high shear stress of the flows. Alternatively, sediment-laden high flows of comparable discharge commonly widen stream channels and deposit mid-channel bars. Changes caused by high flows are due to high rates of bedload transport, readily erodible banks, and local aggradation. High flows with low sediment concentrations and denser flows with high sediment concentrations leave a similar sandy bed. (See also W87-05740) (Author's abstract)
W87-05765

LANDFORM MODIFICATIONS AT A NUCLEAR-WASTE BURIAL SITE,
Geological Survey, Urbana, IL. Water Resources Div.
J. R. Gray.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 242-251, 2 fig, 1 tab, 14 ref.

Descriptors: *Landform modifications, *Nuclear waste, *Disposal sites, *Rainfall-runoff relationships, *Sediment transport, *Sheffield, *Illinois, Waste disposal, Sediment yield, Seasonal variation.

Relations among runoff, sediment transport, landform modifications, and precipitation were evaluated at a 20-acare, low-level radioactive-waste burial site near Sheffield, Ill. Precipitation, runoff, and sediment discharge were measured in three basins comprising two-thirds of the site are and in a 3.5-acre basin in undisturbed terrain 0.3 miles south of the site. The effects of slope, land use, and physical characteristics of surficial material on runoff and sediment transport were evaluated at four plots averaging 114 sq ft in size - two onsite and two in the undisturbed basin. Preliminary results indicate the mean annual precipitation of 36 inches from July 1982 through June 1984 produced a mean of 8 inches of runoff annually from the site, compared to less than a mean of 2 inches of runoff annually from the undisturbed basin. Mean annual storm-sediment yields from the site of 2 tons/acre were more than 200 times greater than yields from the undisturbed basin. A total of 302 collapse cavities were documented at the site from October 1978 through September 1985. Two-thirds of the collapses occurred in the months of February, March, and April. Sixty-two percent of the collapses occurred in swales or near trench boundaries. Approximately three times more soil is moved downward by collapse than by surface transport. (See also W87-05766) (Author's abstract)
W87-05766

SEDIMENT YIELD OF THREE DRAINAGE BASINS IN GUAM,
Geological Survey, Honolulu, HI. Water Resources Div.
P. Shade.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 252-260, 3 fig, 3 tab, 10 ref.

Descriptors: *Sediment yield, *Guam, *Catchment basins, *Ylig basin, *Ugum basin, *Talofofo basin, *Rainfall-runoff relationships, Surface runoff, Flow rate, Sedimentation rate, Mathematical analysis, Mathematical equations, Oahu, Hawaii, Tropical regions.

Nearly all surface runoff on Guam occurs in the southern part of the island where steep volcanic uplands are dissected by numerous streams. The mean annual rainfall in the area is about 100 inches and typhoons as well as droughts are common. Sediment yields for three drainage basins in southern Guan were estimated using flow-duration and sediment-rating curves, and the PSIAC (Pacific Southwest Inter-Agency Committee) formula. The PSIAC estimates of total sediment yield are 1,200 tons/yr/sq mi for the Talofofo, 1,385 tons/yr/sq mi for the Ylig, and 1,210 tons/yr/sq mi for the Ugum basins. These estimates compare favorably with estimates of sediment yields from several similar basins on the island of Oahu, Hawaii. It appears that the PSIAC method can be useful in estimating sediment yields in some tropical areas. (See also W87-05741) (Author's abstract)
W87-05767

HYDROPOWER IMPACTS ON EROSION AND SEDIMENTATION,
Corps of Engineers, Kansas City, MO. Kansas City District.
W. M. Linder, and T. C. Wei.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 261-270, 7 fig, 7 ref.

Descriptors: *Hydroelectric power, *Erosion, *Sedimentation, *Harry S. Truman Dam, *Missouri, Reservoir silting, Bank erosion, Bank stabilization, Simulation analysis, Mathematical studies, Model studies.

The Harry S. Truman (HST) Dam and Reservoir, located in the headwaters of the Lake of th Ozarks, includes hydropower and flood control as project functions. During design and construcction numerous concerns were expressed that peaking power operations would cause extensive downstream bank erosion and resuspension of the existing sediment deposits in the Lake of the Ozarks. In response to these concerns, a study was undertaken to identify the probable extent of erosion of the cohesive soils found in the bed and banks of the upper Lake of the Ozarks. Bank stability studies showed little potential for instability resulting from power operation, and there is little, if any, evidence of bank failures. There has been generalized bank erosion in the first few miles downstream of HST. However, the rate of erosion hs been slow, 1 to 2 ft/yr, and the bank line appears to be beaching at some slopes. A number of factors contribute to

bank erosion other than direct removal of soil particles by the flow. Wetting and drying, and freezing and thawing, loosen the soil particles at the surface and make them more easily removed by the flow. Wave action by boat wakes also appears to be a major cause of bank erosion. Mathematical simulation of the hydrodynamics and sediment transport downstream of hydropower plants can be an effective tool for predicting probable impacts. However, it requires a substantial effort in collecting adequate data for model input, calibration, and verification. The monitoring program shows there is generally good agreement between predicted and observed stage fluctuations and flow velocities downstream of HST. Collection of adequate sediment transport data for direct comparison with model predictions is difficult, but trends observed to date support model predictions. (See also W87-05741) (Lantz-PTT)
W87-05768

EROSION AND SEDIMENT YIELD FROM FLATLANDS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
C. E. Murphree, and C. K. Mutchler.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 271-280, 2 fig, 4 tab, 13 ref.

Descriptors: *Soil erosion, *Sediment yield, *Erosion, *Flatlands, *Deltas, *Mississippi River, Universal Soil Loss equation, Rainfall-runoff relationships, Particle size, Mathematical equations, Watersheds, Slope degradation, Erosion rates.

Sediment yield and erosion research has been conducted on the flatlands of the Mississippi Delta since 1972. This report reviews that research and summarizes sediment yield studies under natural rainfall and other research, using the rainfall simulator, to adapt the Universal Soil Loss Equation (USLE) for use on low slopes. Rainfall, runoff, sediment yield, and sediment particle size data from three flatland watersheds with drainage areas of 15.6, 18.7, and 259 ha have been summarized. Sediment yield prediction equations are derived for the two smaller watersheds. Size distributions of sediments from the two smaller watersheds (15.6 and 18.7 ha) are compared with outflow sediments from the larger 259 ha watershed. Early results established the seriousness of erosion on low slopes - the average annual sediment yield was 29 t/ha froma 16-ha watershed. When the effect of a natural 1.6-ha pond below the watersheds was included, the annual sediment yield was reduced to 6 t/ha; however, the excessive rate of erosion on the cropland was unchanged. Sediment yield from a larger, 259-ha, watershed was 5.2 t/ha/yr for a 6-yr average. This watershed has natural slopes, numerous depressions, and mixed crops. Measured sediment yield from this large, natural Delta watershed was not much less than from the smaller watersheds that included a pond. However, deep tillage on the larger watershed was credited with contributing to less runoff which reduced sediment yield. Sediment transport capacities for the low slpes of the Delta are low, yet suspended clay and fine silt were easily transported. About 95% of the sediment outflow from all the research watersheds was finer than 0.016 mm. (See also W87-05741) (Lantz-PTT)
W87-05769

SAGEBRUSH RANGELAND EROSION AND SEDIMENT YIELD,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. W. Johnson, and N. D. Gordon.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 281-290, 3 fig, 4 tab, 17 ref.

Descriptors: *Erosion, *Sediment yield, *Reynolds Creek, *Idaho, *Soil erosion, Watersheds, Runoff, Rainfall-runoff relationships, Range management, Simulation analysis.

Runoff, erosion, and sediment transport in the Reynolds Creek Experimental Watershed have been studied for about 20 years. Results show that sediment yields are mainly from rainfall events below about 1400 m elevation and from snowmelt-associated events above that elevation. Sediment yields ranged from near zero amounts in drought years to over 3 times the mean value in flood years. In 4 of 18 years at the Reynolds Outlet sampling station, the single largest storm event contributed over 50% of the yearly sediment yield. Bedload transport samples during a peak flow event showed that the maximum transport rate, 400 kg/min/m, near the stream center was about 6 times the mean in the cross-section. Rainfall simulation-soil loss studies were conducted to determine Universal Soil Loss Equation soil erodibility, and cover-management values on sagebrush rangeland sites. (See also W87-05741) (Author's abstract)
W87-05770

SEDIMENT YIELD FROM A GULLY,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
N. H. Welch.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 291-300, 3 fig, 3 tab, 6 ref.

Descriptors: *Sediment yield, *Gullies, *Soil erosion, *Gully erosion, Watersheds, Least squares method, Mathematical studies, Sedimentation, Precipitation, Sediment transport, Statistical analysis.

Rainfall, runoff, and sediment yield were measured from a 0.599-ha gullied watershed with a gullied area of 22%. Rainfall, total watershed runoff, runoff from the ungullied area of the watershed, and runoff volume times peak runoff rate for 72 storms were fitted by linear and logarithmic least square analyses to the sediment yield from the gullied area of the watershed. The equations developed were used to predict sediment yields from the gullied area for comparison with measured yields for 64 storms. Runoff volume times peak runoff rate explained a larger percent of the variation in sediment yield from gullied area than the other variables. Negative yields were predicted by four of the linear equations at low values of the independent variables. There was a trend with all of the equations for the error to increase as the independent variable increased. Prediction errors were as high as 80 to 90% for some of the larger storm events. Neither precipitation nor runoff is the sole factor in gully erosion. However, runoff is the transporting agent and the eroding agent to varying degrees. The unexplained variation is due to changes in the susceptibility and availability of material for erosion and transport, and to changes in watershed hydrologic conditions. These variables, or the variables which the interactive and confounding effects of these variables make their study under field conditions extremely difficult. (See also W87-05741) (Lantz-PTT)
W87-05771

EPHEMERAL GULLIES AS SOURCES OF SEDIMENT,
Colorado State Univ., Fort Collins. Engineering Research Center.
C. R. Thorne, L. W. Zevenbergen, E. H. Grissinger, and J. B. Murphey.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 301-309, 6 fig, 10 ref.

Descriptors: *Ephemeral gullies, *Soil erosion, *Gully erosion, *Sedimentation, Surface runoff, Soil loss, Rill erosion, Channel erosion, Tillage, Swales.

Ephemeral gullies form in swales where concentrated surface runoff occurs due to flow convergence. Current methods of estimation do not properly account for erosion caused by ephemeral gullying. Cooperative research between the Engineering Research Center, Colorado State University, and the USDA-ARS Sedimentation Laboratory, has identified the topographic controls of ephemeral gully size and location. These controls form the basis for a simple, preliminary technique to predict ephemeral gully erosion. The study has revealed that ephemeral gullies experience repeated cycles of cut and fill between tillage events so that actual soil loss due to concentrated flow may be several times the volume indicated by periodic measurements of channel cross-sectional area. Also, ephemeral gullies may increase rill and interrill erosion and accelerate the removal of the detached soil from the field. In addition, their infilling during tillage operations is in effect, a form of mechanical erosion. Consequently, ephemeral gullies are extremely damaging in ways that go far beyond the erosion due to the cutting of the gully channel. Evaluation of the true role of ephemeral gullies in field erosion systems requires a process-based hydrology and sedimentation model. (See also W87-05741) (Author's abstract)
W87-05772

SEDIMENT IN MUGU LAGOON, VENTURA COUNTY, CALIFORNIA,
Soil Conservation Service, Davis, CO.
L. J. Steffen.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 310-320, 3 fig, 14 ref.

Descriptors: *Sedimentation, *Mugu Lagoon, *California, Salt marshes, Lagoons, Sedimentation rates, Environmental effects.

Mugu Lagoon is one of the last remaining natural salt marsh systems in southern California. In the last 80 years, sedimentation in the lagoon has increased from a geologic rate of 0.17 ft/century to an accelerated rate of 1.5 to 3.3 ft/century. If the present rate remains the same, by the year 2030, sedimentation will increase upland habitat from 125 acres to 570 acres while decreasing salt marsh habitat from 1,130 acres to 685 acres. (See also W87-05741) (Author's abstract)
W87-05773

CESIUM-137 MEASURES EROSION RATE AND SEDIMENT MOVEMENT,
Agricultural Research Service, Durant, OK.
J. C. Lance, S. C. McIntyre, B. L. Campbell, R. R. Lowrance, and R. L. Miller.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 323-331, 5 fig, 7 ref.

Descriptors: *Tracers, *Cesium radioisotopes, *Sediment transport, *Erosion rates, *Clay, Vertical distribution, Cultivation, Oklahoma, Slope degradation, Georgia, Soil loss, Sediment distribution, Land management.

Soils of the world are labeled with cesium-137 as a result of fallout from nuclear tests. The radioactive cesium moves with the clay because it is tightly adsorbed. Therefore measurements of the redistribution of radioactive cesium can be used to estimate erosion and sediment deposition rates. Measurements of cesium-137 concentrations in uneroded soils across the southern U.S. indicated that the cesium-137 input was proportional to the average annual rainfall. Vertical distribution of cesium-137 within the profile was related to soil properties rather than to rainfall. Cesium-137 concentartions decrease exponentially from the surface downward in uncultivated soils but concentrations are uniform throughout the plow layer of uncultivated soils. Therefore, different techniques are needed to measure erosion rates on cultivated land, forest land and range land. Similar concentration profiles in a forest and an adjacent clear-cut area with a steep slope in Oklahoma indicated little erosion or mixing of the soil profile by the forest harvesting procedures. Comparisons of total cesium-137 activities in a forested area and a nearby peanut field in the coastal plain of Georgia indicated extensive losses of clay from the cultivated field. Techniques for accurately estimating volumes of soil need additional refinement, but the method shows promise as a useful tool for measuring soil loss and sediment deposition and for understanding erosional processes. (See also W87-05741) (Author's abstract)

W87-05774

APPLICATION OF 10-BE TO THE STUDY OF EROSION AND SEDIMENT TRANSPORT,
Carnegie Institution of Washington, DC. Dept. of Terrestrial Magnetism.
L. Brown, F. Tera, N. Valette-Silver, M. J. Pavich, and J. Klein.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 332-341, 3 tab, 20 ref.

Descriptors: *Beryllium radioisotopes, *Tracers, *Erosion, *Sediment transport, Soil erosion, Particle size, Mathematical studies, Sedimentation, Basins.

The radioactive isotope 10-Be (1,500,000 yr) is produced in the atmosphere by cosmic rays and descends on the earth primarily in rain and snow. Present evidence indicates that it is generally tightly bound to soil, having soil to water partition coefficients of 100,000 and 1,000,000, thereby requiring periods of 100,000 yr to penetrate a few meters of fine grained regolith. Measurements of the dissolved isotope in ground and river water indicate that to a good approximation the isotope's subsequent transport is by particulate matter. Based on this characteristic, a new method for examining the erosion and transport of soils and sediments is introduced. By measuring the 10-Be concentration in the sediment carried by a stream from a basin, one can compare (providing sediment transport data are available) the rate at which atoms leave the basin with the rate at which they are deposited in it. Owing to the large inventory known to exist in soils and to decay there, this ratio must be less than unity for steady state 10-Be deposition and erosion. Measurements are presented and their possible utility as diagnostics discussed. (See also W87-05741) (Author's abstract)
W87-05775

FACTORS AFFECTING ACCURACY OF BED-LOAD SAMPLING,
Geological Survey, Denver, CO. Water Resources Div.
D. W. Hubbell, and H. H. Stevens.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 342-351, 5 fig, 11 ref.

Descriptors: *Sediment transport, *Bed load, *Sampling, *Calibrations, Model studies, Mathematical analysis, Particle size, Hamamori's distribution, Simulation analysis, Sediment distribution.

The accuracy of bedload measurements is affected by sampler calibration and sampling procedures. Both of these factors are greatly affected by the extreme temporal rate variations that occur naturally, even during steady-flow conditions, as a part of the process of bedload transport. Laboratory and field measurements for constant-flow conditions demonstrate that bedload-transport rates of sand and gravel vary markedly with time, from zero, or almost zero, to about four times the mean transport rate. The existence of these extreme temporal variations in transport rate complicate bedload-sampler calibrations and bedload-sampling procedures. Calibration curves developed for a group of tested bedload samplers show that, generally, the relationship between true and sampled rates is not linear for particles ranging in size from 1.4 to 32.0 mm. A mode based on Hamamori's distribution has been developed to generate temporal records of bedload transport. Simulated records produced with the model have been used to examine errors that might result from using various sampling procedures for computing the mean transport rate in cross sections having different hypothetical lateral transport-rate distributions. Simulations show that (1) maximum probable percentage errors are extremely large whenever only a few samples are collected at each lateral sampling position; (2) for a given number of sampling repetitions, maximum probable errors are smaller when 20 lateral positions, rather than 4, are sampled; (3) errors are greatest in cross sections where the lateral distribution of mean transport rate is extremely nonuniform; and (4) possibly, sampling effort can be decreased without increasing errors by sampling repetitively at only a few critically selected lateral positions. Based on theoretical considerations, it may be possible to use information on bed elevations at the times and places of sampling to enhance the accuracy of sampled rates. However, a preliminary scheme using relative bed elevations was unsuccessful. (See also W87-05741) (Lantz-PTT)
W87-05776

SEDIMENT TRANSPORT IN GOODWIN CREEK,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
J. C. Willis, R. W. Darden, and A. J. Bowie.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 352-360, 2 fig, 2 tab, 5 ref.

Descriptors: *Sediment transport, *Goodwin Creek, *Mississippi, *Sediment concentration, Mathematical equations, Sampling, Particle size, Channels, Dunes, Regression analysis, Mathematical analysis.

Concentrations of sands and fine sediments that have been collected since about 1980 in Goodwin Creek, MS, are used to develop tenative regression equations with depth of flow in the critical flow structures. Depth-integrated samples define the best estimates of the average sand concentrations while automatic pump samples provide the best coverage of storm events and adequate accuracy for fine sediment concentrations. Attempts to measure the gravel loads with a bag-type sampler are beginning. At any given stage (depth), the observed concentrations vary depending on the passage of dunes, sediment waves, and watershed/channel conditions. A correction factor is introduced into the regressino equations and updated at each average concentration observation to estimate sediment yields during observed flows. The uncorrected regression equations may be used to estimate expected yields by unmeasured or hypothetical flows in the channels. (See also W87-05741) (Author's abstract)
W87-05777

LABORATORY STUDY OF SEDIMENT TRANSPORT UNDER ICE,
Cold Regions Research and Engineering Lab., Hanover, NH.
J. L. Wuebben.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 361-369, 5 fig, 8 ref.

Descriptors: *Sediment transport, *Ice, *Alluvial channels, *Laboratory analysis, Water temperature, Shear stress, Boundary processes, Flumes, Cold regions, Sedimentation.

The influence of an ice cover on flow in an alluvial channel involves a complex interaction between the ice cover, fluid flow, fluid properties, sediment and bedforms. The presence of an ice cover changes an open channel into a form of closed conduit, which in turn affects the magnitude and distribution of velocities as well as the boundary and internal shear stresses. In addition, the colder water temperatures affect fluid properties important to the transport of sediment. Further, the boundary roughness is not constant since the interaction between the ice cover and bed may induce a change in boundary form with time and location. This paper discusses the results obtained in a 36-m-long refrigerated, recirculating flume that is 1.2 m wide and 0.6 m deep. The bed composed of a uniform 0.45-mm quartz sand. For a given discharge the flume was first operated as an open channel until essentially uniform equilibrium conditions were attained. Runs were then repeated with the addition of simulated smooth and rough ice covers at the same discharge and flume slope, allowing depth to vary. The test results were used to examine the effects of an ice cover on bedform, resistance to flow and total sediment transport. (See also W87-05741) (Author's abstract)
W87-05778

ACCURACY OF SEDIMENT DISCHARGE ESTIMATES,
Geological Survey, Harrisburg, PA.
T. H. Yorke, and J. R. Ward.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 370-380, 3 fig, 6 tab, 3 ref.

Descriptors: *Sediment discharge, *Estimating, *Sediment transport, *Schuylkill River, *Manayunk, *Pennsylvania, Graphical analysis, Statistical analysis, Sediment concentration, Discharge rates, Regression analysis, Mathematical analysis.

The accuracy of various methods for estimating long-term suspended-sediment discharge was evaluated by comparing the discharge measured at a long-term daily sediment station with the discharge estimated by 24 different methods. The flow-duration, suspended sediment transport curve procedure was the basis for all the methods. Differences between the methods were the types of curves, the dependent variable, and how the curves were determined. Types of curves included a single curve, two seasonal curves (dormand and growing seasons), and three size fraction curves (sand, silt, and clay). Relations between sediment concentration, sediment discharge, and water discharge wre developed for each type of curve. The curves wre computed by linear and nonlinear regressions or hand drawn through average sediment concentration or sediment discharge values within specified water discharge intervals. Daily suspended sediment discharge records and particle size determinations for the Schuylkill River at Manayunk, Pennsylvania, were used in the analyses. After comparing the discharges estimated by the 24 methods with the measured discharge, three of the more suitable methods were tested with data from other daily sediment stations. Five stations with drainage areas ranging from 10.2 to 24,100 sq mi were used to evaluate the suitability of the methods for both smaller and larger streams. The linear regression and group average methods of relating sediment concentration or sediment discharge to water discharge produced suitable estimates of long-term discharge. None of the methods produced good estimates for the small streams. (See also W87-05741) (Author's abstract)
W87-05779

LOCAL SCOUR AT DROP STRUCTURES,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
E. M. Laursen, M. W. Flick and, and B. E. Ehlers.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 381-390, 7 fig, 7 ref. Federal Highway Administration Contract No. HPR-1-19 (184).

Descriptors: *Scour, *Drop structures, *Erosion, Slope degradation, Mathematical analysis, Sediment yield, Bed load, Riprap, Tailwater, Sediment transport.

The scour at the toe of a vertical wall and at the toe of a sloping sill were investigated experimentally and analytically. Approximate relations for predicting the ratio of the scour depth to the (energy) critical depth were obtained for the two geometries. For the vertical wall, the sediment scoured out left in suspension, and the parameters needed to describe the scour phenomenon were the ratio of the (energy) critical velocity to the fall velocity and the drop in water surface in ratio to the critical depth. For the sloping sill, which is the recommended geometry, the sediment scoured out left as bed load, and the parameters needed to describe the scour phenomenon were the critical depth/sediment size ratio and the ratio of the size of the riprap protecting the sill slope to the critical depth. A follow-up study of flow and scour characteristics for a vertical drop followed by an apron resulted in rules for determining the length of

apron required and the range of tailwater for proper flow. (See also W87-05741) (Author's abstract)
W87-05780

SEDIMENT SOURCES AND SEDIMENT-TRANSPORT CURVES,
Geological Survey, Menlo Park, CA.
K. M. Nolan, R. J. Janda, and J. H. Galton.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 391-400, 3 fig, 2 tab, 19 ref.

Descriptors: *Sediment transport, *Mathematical analysis, *Water pollution sources, *California, Suspended sediments, Streams, Erosion, Channels, Sediment erosion.

Studies of suspended-sediment transport in nine streams in northwestern California indicate that slopes and intercepts of suspended sediment transport relationships are controlled by sediment sources and delivery processes. In terrain underlain by noncoherent rocks, sediment within channels is abundant and sediment transport relationships can be adequately described by single relationships which operate at relatively high levels. In terrain underlain by coherent rocks, sediment delivery to channels is more episodic and muultiple relationships are required to adequately describe suspended sediment transport relationships. Recognizing the interaction between the form of suspended sediment transport relationships and dominant sediment sources, aids in selecting the most appropriate relationship for a given water discharge and places such calculations on a sound basis with respect to drainage basin processes. (See also W87-05741) (Author's abstract)
W87-05781

MISSOURI RIVER SEDIMENT TRANSPORT RELATIONSHIP,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. W. Shen, and W. C. Wang.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 401-411, 1 fig, 3 tab, 11 ref.

Descriptors: *Sediment transport, *Yankton, *Sioux City, *Iowa, *Omaha, *Nebraska, *Nebraska City, *Missouri River, *Gavins Point Dam, Mathematical studies, Flow rate, Distribution analysis, Rouse's equation, Vertical distribution, Bed load, Sedimentation.

A comprehensive sediment and flow data collection program has been conducted at Yankton, Sioux City, Omaha, and Nebraska City, since the closure of the Gavins Point Dam in 1955. This is the most detailed set of field data for suspended sediment transport rate studies available at this time. A sediment transport relationship was first developed based on these data. From this development, it was determined that (1) Toffaleti's flow velocity distribution was valid with the modification in which n (the exponent of the power law type of velocity distribution) is a function of sediment size, flow velocity and water temperature; (2) the vertical suspended sedimenat concentration profile in the entire flow depth can be treated as a single zone for the Missouri River rather than the three or four zones as proposed by Toffaleti; (3) a correction factor, C, needs to be multipled to the well known Z value in Rouses's equation for vertical suspended sediment concentration distribution; and (4) a reference bed layer is needed to define the bed load sediment concentration. Unlike Einstein's assumption that the bed layer is equal to two times the sediment sizes, the thickness of bed layer is found to be a function of a Froude Number of the sediment particle size. Another result of the study was the comparison of selected well-known sediment transport relationships. (See also W87-05741) (Author's abstract)
W87-05782

DENUDATION RATES IN SELECTED DEBRIS-FLOW BASINS,
Geological Survey, Reston, VA.
W. R. Osterkamp, and J. E. Costa.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 412-420, 1 fig, 2 tab, 15 ref.

Descriptors: *Erosion, *Denudation, *Debris flows, *Mount Shasta, *California, *Mount Elbert, *Colorado, *Blue Ridge, *Virginia, *Sediment yield, *Slope degradation, Erosion, Mountains, Channel erosion, Stream discharge, Erosion rates.

Denudation rates resulting from debris flows on Mount Shasta, California, on Mount Elbert in central Colorado, and in the Blue Mountains in Nelson County, Virginia, were determined by measuring volumes and ages of deposits. Results show that, where debris flows are frequent, denudation rates can be very high. If the debris is stored on lower slopes without entering the stream system, short-term sampling for sediment yield at streamflow gages sediment sediment yields fails to reflect erosion in higher parts of the basin, and sediment delivery ratios may approach zero. Data from the debris-flow areas provide extreme examples of sediment storage that may also be common in fully fluvial systems. They show that disequilibrium between hillslope and channel sediments may prevail over periods ranging from less than a decade to thousands of years. (See also W87-05741) (Author's abstract)
W87-05783

MISSOURI RIVER AGGRADATION AND DEGRADATION TRENDS,
Army Engineer District, Omaha, NE.
W. J. Mellema, and T. C. Wei.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 421-430, 4 fig, 5 tab.

Descriptors: *Missouri River, *Aggradation, *Degradation, *Dams, Suspended sediment, Flood control, Sediment yield, Sedimentation, Reservoirs, Aggrading rivers.

The U.S. Army Corps of Engineers, Missouri River Division, has constructed six large multipurpose dams in tandem along the upper Missouri River for flood control, power production, irrigation, water supply, augmentatino of river discharges for navigation and water quality, recreation, and fish and wildlife benefits. These dams now intercept the sediment from one of the most sediment producing regions in the continental United States. Sediment measurement records indicate that an average of 135 million tonsof sediment per year was transported by the river as suspended load prior to construction of the dams. Most of the sediments previously passing through the system are now deposited within the six-dam river-reservoir system. This has had a far-reaching influence, not only within the individual reservoir projects themselves, but also on the open river reaches between the projects and downstream from the lowest dam. (See also W87-05741) (Author's abstract)
W87-05784

PATTERNS OF SEDIMENT DEPOSITION IN SHALLOW BAYS,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
F. C. Wang, W. H. McAnally, and J. S. Wei.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 431-440, 6 fig, 19 ref. Army Engineer Contract No. DACW39-82-0085.

Descriptors: *Sedimentation, *Sediment distribution, *Bays, *Sediment transport, *Mississippi River, *Atchafalaya River, *Mathematical analysis, Deltas, Delta lobes, Suspended sediments, River discharge.

The diversion of freshwater and sediment from the Mississippi River to the Atchafalaya River is developing a new land mass (delta lobes) on the south-central Louisiana coast. Summarized here is an analytical method to predict the patterns of sediment deposition, and the subaerial delta growth in the bay. The method is based on the theory of turbulent plane jets which issue from river mouths and discharge into a quiescent, well-mixed and shallow bay. Results show that the deposited sediment forms a saddle-shaped bottom. Rapid accumulation of suspended sediments near the river mouth and abrupt decline of sediment deposition away from the mouth are obtained. It is inferred that in a shallow bay the river discharge has a significant influence in sediment deposition patterns over a short distance, and that beyond that distance the river discharge is insignificant. (See also W87-05741) (Author's abstract)
W87-05785

COLORADO RIVER SEDIMENT TRANSPORT IN GRAND CANYON,
E. L. Pemberton, and T. J. Randle.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 441-451, 5 fig, 1 tab, 7 ref.

Descriptors: *Colorado River, *Sediment transport, *Grand Canyon, *Environmental effects, *Glen Canyon Dam, Hydroelectric plants, Suspended sediments, Flow velocity, Temporal distribution, Sand, Gravel, Model studies.

The generating units at the Glen Canyon Dam Powerplant will be uprated and rewound by 1987. This means that the powerplant will have an increased capacity to fluctuate flows and generate more revenue. Because of this new capacity, studies were initiated to evaluate the short and long term environmental impacts to recreation, fisheries, vegetation, and beach erosion of the Colorado River through Grand Canyon National Park. The U.S. Geological Survey, under an agreement with the U.S. Bureau of Reclamation, collected suspended sediment samples, bed material samples, velocity measurements, and cross section data. These data were collected at five sampling stations on the Colorado River and three tributary stations between Lees Ferry and Diamond Creek. The sampling period contains two flow conditions: one of declining large discharges ranging from 90,000 to 21,000 cu ft/s, from June to December 1983, and the other will consist of a daily peaking operation at Glen Canyon Dam with flow ranging from 3,000 to 28,000 cu ft/s from October 1985 through January 1986. (See also W87-05741) (Author's abstract)
W87-05786

PROBABILITY DISTRIBUTIONS FOR BED-LOAD TRANSPORT,
Geological Survey, Nashville, TN. Water Resources Div.
W. P. Carey, and D. W. Hubbell.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 452-461, 5 fig, 2 tab, 14 ref.

Descriptors: *Bed load, *Sediment transport, Probability distribution, Flow patterns, Flow rate, Statistical analysis, Distribution analysis, Mathematical analysis, Mathematical equations, Morphology.

Bedload transport rates at a fixed point fluctuate widely with time, even with a steady-flow condition. When the bed is formed into dunes, the transport rate varies from zero or near zero in the troughs to a maximum at the crests. Although documentation is sparse, rate fluctuations at a point also seem to occur even when bed forms are not distinct. An existing probability distribution function can be used to describe bedload transport for steady flow over a dune bed. According to this distribution, transport rates vary from zero to four times the mean, and 60% of all rates are less than the mean. Several sets of measured transport rates from dune beds show good agreement with this distribution even though these sets were collected form a variety of bed materials using different types of samplers. The maximum transport rate of

four times the mean and the resulting shape of the distribution are specific to the geometric assumptions made in the derivation. The derivation can be extended, by suing general rather than specific geometric assumptions, to yield expressions for a family of distribution functions. This generalization results in two simple equations for determining the maximum relative transport rate and the variance of any assumed distribution. The variance of a given distribution can then be used to examine the accuracy of sample sets consisting of various numbers of observations. Since these functions are free of specific geometric constraints, their potential applications are not restricted to specific bed forms. (See also W87-05741) (Author's abstract)
W87-05787

BED FORM PREDICTORS FOR HIGH SEDIMENT LOADS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. B. Bradley, and J. D. Graham.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 462-472, 9 fig, 2 tab, 8 ref.

Descriptors: *Volcanoes, *Sediment load, *Bed load, *Mt. St. Helens, *Toutle River, *Washington, *Cowlitz River, Sediment transport, Sand, Detritus, Avalanches, Erosion, Flow pattern, Flow rate, Mathematical analysis, Sediment concentration, Sedimentation, Wash load.

During the Mt. St. Helens eruption 18 May 1980, a debris avalanche deposited some two and one-half billion cu m of rock, ice, and other material in the upper twenty-seven kilometers of the North Fork Toutle River Valley. Mud flows triggered by the eruption carried large volumes of sediment from the debris avalanche into the Toutle, Cowlitz, and Columbia Rivers. Three years after the initial eruption, large volumes of sediment continue to be delivered to these rivers from the debris avalanche. High wash load (less than 0.062 mm) concentrations significantly affect streamflow characteristics and bed material transport (sand) in the river system. As the wash load concentration increases, fluid viscosity increases, the sediment particle fall velocity decreases, and bed material transport increases. Variations in wash load concentration alters bed forms which in turn influence peak flows and travel times from the upper watershed, and water surface elevations in the Cowlitz River. Water surface profiles have varied as muchas one meter in the Cowlitz when dunes have transitioned to a plane bed as a result of high wash load concentrations. Four bed form predictors are compared and an approach presented which incorporates sediment concentration as these which other methods do not include as a variable. (See also W87-05741) (Author's abstract)
W87-05788

SUSPENDED-SEDIMENT TRANSPORT, LAKE TAHOE BASIN,
Geological Survey, Menlo Park, CA.
J. H. Galton, and K. M. Nolan.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 473-482, 2 fig, 3 tab, 18 ref.

Descriptors: *Suspended sediment, *Lake Tahoe, *Sediment transport, *Sediment load, Streamflow, Sediment discharge, Runoff, Snow cover, Seasonal variation.

Analysis of magnitude and frequency of suspended sediment transport in four tributary streams of Lake Tahoe indicated that from 1973 to 1981 suspended sediment was transported primarily by frequent, moderate streamflow. Spring snowmelt transported 73.8% of the total annual suspended sediment load. Ninety percent of the suspended sediment in these four streams was transported by flows that occurred more than 1.4 days/yr. Less than 13% of the total suspended sediment load was transported by flows that occurred only 1% of the time. The relationship of suspended sediment discharge to water discharge was found to depend upon factors such as amount of snow cover and the type of runoff that produced streamflow. Data were divided into four groups according to the time of year during which different runoff processes prevail and were further subdivided into high and low discharge classes within each seasonal group. (See also W87-05741) (Author's abstract)
W87-05789

ISSUES IN SEDIMENT RESEARCH IN RIVERS OF THE U.S.,
Geological Survey, Denver, CO.
R. H. Meade, and R. S. Parker.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 483-489, 1 tab, 24 ref.

Descriptors: *Sediment transport, *Path of pollutants, *Fate of pollutants, *Sedimentation, *Rivers, *Research needs, Dams, Reservoir, Sediment storage, Storms, Mississippi River, Sediment load, Sediment transport.

Among the issues and problems that concern the sediment in rivers of the United States are: the effects of dams and reservoirs, the implications of sediment storage, and the importance of large infrequent storms. Dams and reservoirs have diminished by half the amount of sediment that the Mississippi River formerly transported to its delta. They have almost completely stopped the seaward transport of sediment by two other great rivers of the country, the Colorado and the Grande. The storage of sediment in river valleys at different time scales is a problem that requires urgent attention because, until it is more clearly understood, prediction of the fate of many of the pollutant substances that are found in the nation's rivers are difficult. Furthermore, a better understanding of the frequencies and magnitudes of the very largest sediment-transporting events will improve the ability to predict the rates at which sediment is discharged by rivers. (See also W87-05741) (Author's abstract)
W87-05790

PROCEEDINGS OF THE FOURTH FEDERAL INTERAGENCY SEDIMENTATION CONFERENCE.
Interagency Advisory Committee on Water Data, Reston, VA. Subcommittee on Sedimentation.
March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. 497 p.

Descriptors: *Sedimentation, *Conferences, Instrumentation, Erosion control, Sediment control, Sediment yield, Sediment transport.

These proceedings of the Fourth Federal Interagency Sedimentation Conference contain 102 technical papers, in two volumes, which were submitted by representatives of 11 Federal agencies for presentation at the conference. The papers are organized under eight general topics, four of which are discussed in this, Volume II. These are: instrumentation, erosion and sediment control, sediment yield and sources, and sediment transport and deposition. (See also W87-05740; W87-05792 thru W87-05842) (Lantz-PTT)
W87-05791

VERIFICATION OF SEDIMENT TRANSPORT FUNCTIONS,
George Washington Univ., Washington, DC.
K. Mahmood, W. G. Dorough, and M. I. Haque.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. p 5-1 to 5-10, 1986. fig, 2 tab, 8 ref.

Descriptors: *Sediment transport, *Mathematical studies, *Mathematical equations, *Missouri River, *Data interpretation, Particle size, Bed load, Sedimentation.

Twelve sediment transport functions were compared to study their predictive accuracy. These functions are: (1) Modified Einstein Procedure, (2) Einstein's Bed Load Function; (3) Mahmood's Transport Function; (4) Toffaleti's Method; (5) Colby's Procedure; (6) The Modified Colby Method; (7) Meyer-Peter and Muller's Formula; (8) Engelund-Handson's Formula; (9) Acker-White's Function; (10) Yang's Stream Power Relation; (11) Laursen's Function; and (12) Shen-Hwang's Method. The results are compared with those obtained by the Modified Einstein Procedure (MEP). The study is based on 97 field measurements of sediment and hydraulic variables in Missouri River. Im comparing the results, whenever possible, both the bed material concentration and its particle size distribution were considered. The following conclusions were drawn: (1) Among the methods that predict the bed material load and its particle size distribution, the two methods that best fit the observed data are Toffaleti's and Shen-Hwang's. Toffaleti's method better fits the MEP-based estimates and Shen-Hwang's, the PI-data-based estimates. However, the particle size distribution for bed material load is better predicted by Toffaleti's method in both cases; (2) Among those functions which yield bed material load only, Acker-White's method gives the best predictive accuracy; and (3) Particle size distribution of bed material load is best predicted by Toffaleti's method for all categories of data. (See also W87-05791) (Lantz-PTT)
W87-05792

PHOTOGRAMMETRIC ANALYSIS OF CHANNEL ADJUSTMENT,
Geological Survey, Reston, VA.
A. J. Miller.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-11 to 5-20, 2 fig, 1 tab, 13 ref.

Descriptors: *Photogrammetry, *Channel flow, *Aerial photography, *Sedimentation, *Smoky Creek, *Tennessee, *Channel morphology, Sediment distribution, Channels, Aggradation, Erosion.

Comparison of features recorded from successive stereopairs of aerial photographs allows measurement of river-channel migration rates, analysis of changes in channel morphology, and mapping of flood-plain sedimentation patterns. In digital photogrammetry, points and linear features are converted to x, y, and z coordinates, and digitized features can be displayed and compared at any scale and in any combination desired. Measurement precision may be as fine as 1-2 m for photographs with scales of approximately 1:20000 if image quality is good and coordinate systems are carefully matched. An analytical stereoplotter was used to measure channel changes that occurred between 1971 and 1983 at a site on Smoky Creek, a tributary of the New River in Tennessee. Preliminary results indicated that (1) channel widening was associated with deposition of coarse sediment in the channel; (2) channel changes occurred throughout the 12-year period and at least three events caused significant adjustments; (3) initiation of channel adjustment predated strip mining in the Bowling Branch basin just upstream but may have been influenced by strip mining further upstream in the Smoky Creek basin; and (4) aggradation on the flood plain opposite Bowling Branch occurred after the onset of strip mining in the Bowling Branch basin. (See also W87-05791) (Author's abstract)
W87-05793

GEOMORPHIC - HYDRAULIC SIMULATION OF CHANNEL EVOLUTION,
Water Engineering and Technology, Inc., Shreveport, LA.
C. C. Watson, M. D. Harvey, and J. Garbrecht.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-21 to 5-30, 5 fig, 1 tab, 19 ref. Soil Conservation Service Contract Nos. SCS-23-MS-80 and SCS-54-MS-83.

Descriptors: *Geomorphology, *Hydraulic simulation, *Channel morphology, *Sedimentation, Hydraulic models, Channel morphology, Channeling,

Simulation analysis, Numerical analysis, Aggradation, Degradation.

Major incision following channelization, with concomitant channel widening and soil loss, has required the rehabilitation of several north central Mississippi channels. Previous geomorphic and hydraulic research identified a process-based conceptual model of channel evolution which used location-for-time substitution. This was necessary because data was only available for surveys widely separated in time. A numerical simulation procedure based on geomorphic and hydraulic models was used to quantify changes in morphology and channel response. This allowed a year-by-year prediction of soil loss and channel change, which provides information for efficient planning for channel rehabilitation programs. The numerical simulation utilized hydraulic sediment routing to determine channel aggradation and degradation. Bank stability estimates and channel morphologic relationships were used to simulate channel widening. The results of the simulation closely corresponded to channel dimensions 15 years after channelization. (See also W87-05791) (Author's abstract)
W87-05794

CHANNEL WIDTH ADJUSTMENT IN STRAIGHT ALLUVIAL STREAMS,
Agricultural Research Service, Fort Collins, CO.
C. V. Alonso, and S. T. Combs.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-31 to 5-40, 6 fig, 1 tab, 19 ref.

Descriptors: *Channel width, *Alluvial rivers, *Channel morphology, *Sedimentation, Scour, Model studies, Mathematical models, Aggradation, Erosion, Degradation, Bank stabilization.

Alluvial streams construct their own geometries in response to changes imposed by nature or by man. Channel width adjustment was examined by considering separately vertical and lateral scour and fill. The mechanisms associated with these changes were used to formulate a mathematical model of width adjustment during channel aggradation and degradation. The model, although dependent on approximate assumptions and a priori knowledge of certain bank stability properties, reproduces expected behavior with reasonable resolution. (See also W87-05791) (Author's abstract)
W87-05795

PREDICTING CHANNEL ADJUSTMENT TO CHANNELIZATION,
Colorado State Univ., Fort Collins. Dept. of Geology.
M. D. Harvey, C. C. Watson, and J. Bernard.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-41 to 5-50, 3 fig, 4 tab, 15 ref.

Descriptors: *Channel morphology, *Channeling, *Muddy Fork, *Silver Creek, *Elk Creek, *Indiana, *Sedimentation, Bank stabilization, Mathematical analysis, Statistical analysis, Multivariate analysis, Flooding, Least squares method, Regression analysis.

A geomorphic study of Muddy Fork was conducted to determine whether the bed and banks would require armoring if channelization were implemented to reduce the incidence of out-of-bank flooding. The study showed that the entire channel was in a state of disequilibrium, but that it could be divided into an upper eroding reach and a lower relatively stable reach on the basis of the cohesiveness of the perimeter sediments. This was quantified by two separate multivariate least squares regression relationships between channel top width, stream power, d sub 50 and percent silt-clay (M) in the perimeter sediments. Comparison of the ratio of existing to allowable tractive stress in Elk Creek, which had been channelized in 1962 without adverse results, with the two reaches of Muddy Fork confirmed that the lower reach of Muddy Fork did not require armoring, but that the channelized portion within the upper reach would require riprap on the banks. Armoring of the bed is unnecessary because it is controlled by out-crops of shale. (See also W87-05791) (Author's abstract)
W87-05796

SIMILARITY OF BANK PROBLEMS ON DISSIMILAR STREAMS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
E. H. Grissinger, and W. C. Little.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-51 to 5-60, 5 fig, 12 ref.

Descriptors: *Bank protection, *Streams, *Channel erosion, *Black River, *Louisiana, *Mississippi River, Channel morphology, Bank erosion, Atchafalaya River, Ouachita River, Bank stabilization.

the similarities and dissimilarities in channel-bank adjustments for several channels which occupy distinctly different physiographic positions are described. Problem reaches of the Black River, Louisiana, and several small tributaries in northern Mississippi all have excessive depths. The northern Mississippi channels have entrenched due to relatively recent knickpoint incision whereas the depth of the Black River is relic. For all of these channels, the dominant form of bank instability is mass failure, particularly tension crack accelerated slab failure. Failure frequencies for these two channels, however, are expected to be considerably diverse. Worst case failure conditions due to bank saturation are controlled by local climatic conditions for the northern Mississippi creeks. However, high stages on the Black River caused by backwater from the Red, Atchafalaya, and Lower Mississippi Rivers control the development of worst case conditions. An additional difference between these two channels is the occurrence of deep-seated, slip circle failures on the Black River. Although the lower Ouachita River also has excessive channel depths, the banks are generally stable due to stage control by a series of locks and dams. A generalized stabilization strategy is proposed. (See also W87-05791) (Author's abstract)
W87-05797

SEDIMENT STUDIES IN GRAND CANYON, ARIZONA,
Geological Survey, Tucson, AZ.
J. B. Graf, E. L. Pemberton, and J. C. Schmidt.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-61 to 5-70, 2 fig, 16 ref.

Descriptors: *Sedimentation, *Grand Canyon, *Arizona, *Reservoirs, *Glen Canyon Dam, *Colorado River, Sediment transport, Sediment storage, Bed load, Sonar, Model studies, Channel flow, Alluvial deposits.

The effect of impoundment and flow regulation at Glen Canyon Dam on sediment transport and storage in the Colorado River below the dam is being investigated by a combination of analysis of historical data and collection and analysis of new data. Suspended sediment, bed material, and bedload are sampled at three temporary and two long-term gaging stations along the main stem of the Colorado River, and in three of its largest tributaries in the study reach. Side-scan sonar and seismic-reflection surveys provide data on bed materials and channel geometry between gages. A sediment transport model, calibrated with data from the study period, is used to simulate sediment transport and storage for alternative flow-release patterns. Long-term response of the channel to changes in flow conditions and to tributary floods, is determined by analysis of records from the two long-term gaging stations. Alluvial sand bars in the study reach are ecologically and aesthetically important elements of the river corridor. Long-term response of sand bars to flow conditions will be determined through analysis of historical photographs and bar surveys. Short-term responses of bars to fluctuating flows will be determined by repeated topographic mapping and measurement of selected physical and hydraulic variables. Results of main stem, tributary, and bar studies will be integrated to evaluate the effect of fluctuating flows on sediment transport and storage in the study reach. (See also W87-05791) (Authors' abstract)
W87-05798

CHANNEL EVOLUTION IN MODIFIED TENNESSEE CHANNELS,
Geological Survey, Nashville, TN.
For primary bibliographic entry see Field 4A.
W87-05799

VEGETATION AND BANK-SLOPE DEVELOPMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4A.
W87-05800

EVOLUTION OF TWO DREDGED CHANNELS IN OKLAHOMA,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 4A.
W87-05801

CHANNEL ADJUSTMENTS OF THE LOWER COLORADO RIVER,
Bureau of Reclamation, Boulder City, NV.
For primary bibliographic entry see Field 4A.
W87-05802

ALLUVIAL TRENDS: NOTCHED RIVER CONTROL STRUCTURES,
Corps of Engineers, Omaha, NE.
For primary bibliographic entry see Field 4A.
W87-05803

CHANNEL ADJUSTMENTS IN A YAZOO BLUFFLINE TRIBUTARY,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
J. B. Murphey, and E. H. Grissinger.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-123 to 5-132, 5 fig, 3 tab, 7 ref.

Descriptors: *Channel morphology, *Goodwin Creek, *Yazoo River, *Mississippi, *Sedimentation, Sediment transport, Channel improvement, Channel erosion, Precipitation, Runoff.

Channel adjustments during a 6 1/2 year study period (November 1977 - March 1984) of the Goodwin Creek, Mississippi, have been a significant source of sediment, affecting both the study channels and the sediment supply to downstream channels. For this total interval, the net annual scour rate for the 2.81 km channel length between discharge measuring two flumes was 2.68 cu m/m of channel or 7,500 cu m/yr. This rate is equivalent to about 5.5 metric tons/ha (2.4 tons/acre) annual erosion for the contributing watershed area. For the initial 5.02 yr ungaged interval, the comparable rate was 2.78 cu m/m and for the 1.34 yr gaged interval the rate was 2.32 cu m/m, even though precipitation for this latter interval was 29% greater than that of the initial 11-77 to 11-82 interval. Short-term gross and net volume changes are much more variable due to variations in the supply of coarse sediment input to the study channel and to variations in the amount of coarse sediment previously stored in the study channel. (See also W87-05791) (Lantz-PTT)
W87-05804

SONAR PATTERNS OF COLORADO RIVER BED, GRAND CANYON,
Geological Survey, Tucson, AZ.
R. P. Wilson.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-133 to 5-

142, 4 fig, 1 tab, 6 ref.

Descriptors: *Channel morphology, *Sonar, *Colorado, *Grand Canyon, *River beds, *Arizona, Sediment distribution, Gravel, Sedimentation, Sediment discharge, Scour.

Distinctive patterns on side-scan sonar charts and depth-finder charts were used to delineate smooth bottom, sediment waves, and boulders and bedrock outcrops on the bed of the Colorado River in the Grand Canyon, Arizona. Dredged bed-material samples indicate that sand and gravel form smooth bottom in areas of low-velocity currents and sediment waves in areas of intermediate velocity. Gravel and cobbles form a smooth bottom in areas of higher velocity near riffles, rapids, or downstream sides of scour holes. Near the banks, the smooth bottom is mainly sand and commonly extends above the water surface as sand banks. Sediment waves range in amplitude from 0.2 to 1.2 m. The bed-material samples indicate that sediment waves are composed mainly of medium to very coarse sand, fine gravel, and a few medium to large pebbles. The granules and pebbles are mostly subrounded to well rounded and show evidence of sustained transport. Boulders and bedrock outcrops occur at riffles, rapids, upstream sides of scour holes, and along much of the banks. River depths range from 1.5 to 32.3 m at an average discharge of 708 cu m/sec. Scour holes more than 1.5 times deeper than local mean depth occur below many rapids and constrictions. The holes contain cobbles and gravel in the bottom and store little sand. In metamorphic-rock reaches, the river bed is irregular and has near-vertical changes in depth of as much as 15 meters. (See also W87-05791) (Author's abstract)
W87-05805

CHANNEL ADJUSTMENTS AFTER PASSAGE OF A LAHAR,
Geological Survey, Vancouver, WA. Water Resources Div.
H. A. Martinson.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-143 to 5-152, 6 fig, 11 ref.

Descriptors: *Channel morphology, *Volcanoes, *Lahars, *Detritus, *Pine Creek, *Mt. St. Helens, k*Washington, *Sedimentation, Aggradation, Channel erosion, Sediment distribution.

Pine Creek was altered by a large lahar generated during the May 18, 1980, eruption of Mount St. Helens. The nature, magnitude, and persistence of subsequent channel adjustments have been quantified using data from annual surveys of 27 channel cross sections established along the lahar-affected length of the stream and from post-eruption aerial photographs taken periodically. Post-lahar channel adjustments occurred rapidly in repsonse to storm runoff. The channel widened by 3 to 63 m (10 to 305%) at measured cross sections during 1980-81, concomitant with incisions in upstream parts of the basin and aggradation and braiding in downstream reaches. Widening during subsequent years was negligible. In upstream reaches, initial incision was followed by a small amount of aggradation during the 1982-84 water years; in downstream reaches, braiding diminished as the initial aggradation was followed by channel incision and enlargement. The lahar-modified channel has adjusted in response to a combination of factors: (1) heavy rainfall during Novemember 1980, which affected upper parts of the basin that usually are covered with snow, (2) movement of a large volume of sediment from upstream to downstream reaches during the first year folowing the eruption, and (3) higher than normal flood peaks occurring during water years 1982-84 and possibly during water year 1981. (See also W87-05791) (Author's abstract)
W87-05806

EFFECT OF EROSION ON PRODUCTIVITY - EPIC WATER EROSION MODEL,
Agricultural Research Service, Temple, TX. Grassland, Soil and Water Research Lab.
J. R. Williams.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 6-1 to 6-8, 1 fig 7 ref.

Descriptors: *Erosion, *Productivity, *Model studies, *EPIC, *Soil erosion, *Erosion-Productivity Impact Calculator, Simulation models, Simulation analysis, Plant growth, Hydrology, Weather, Nutrients, Soil temperature, Tillage, Economic aspects, Rainfall-runoff relationships, Irrigation.

The Erosion-Productivity Impact Calculator (EPIC) model was developed to assess the effect of soil erosion on soil productivity. EPIC is composed of physically based components for simulating erosion, plant growth, and related processes and economic components for assessing the cost of erosion, determining optimal management strategies, etc. The physical processes involved are simulated simultaneously and realistically using readily available inputs. Since erosion can be a relatively slow process, EPIC is capable of simulating hundreds of years if necessary. The model is generally applicable, computationally efficient, and capable of computing the effects of management changes on outputs. There are nine major components of the EPIC model - hydrology, weather, erosion, nutrients, plant growth, soil temperature, tillage, economics, and plant environment control. EPIC simulated erosion rates and crop yields are used to develop the relationship between erosion and soil productivity (E/P). Two long-term EPIC simulations are performed to establish the E/P for a particular soil and location. Once the E/P is established, any management strategy can be evaluated quickly if the average annual erosion rate is known. Short-cut methods for estimating annual erosion based on the EPIC erosion model are useful in applying the E/P. The E/P provides a means for determining the cost of erosion and for evaluating various conservation strategies. (See also W87-05791) (Lantz-PTT)
W87-05807

ACCELERATED EROSION RISKS VS WATERSHED CONDITION,
Forest Service, Washington, DC.
W. T. Hanes, R. M. Solomon, L. J. Schmidt, and R. A. LaFayette.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 6-9 to 6-18, 4 fig, 26 ref.

Descriptors: *Erosion rates, *Watersheds, *Erosion control, *Sedimentation, Vegetation, Runoff, Ecosystems, Arid lands, Semiarid lands.

A method is presented for displaying the interrelationships of ground cover, runoff, and return period in arid and semiarid landscapes. Similar approaches are possible for forested ecosystems, utilizing the factors that index the hydrologic processes controlling watershed condition in those areas. A single value watershed condition threshold, sensitive by ecosystem, is displayed within the context of the relationship between ground cover and the risk of experiencing a storm which will cause accelerated erosion. Reducing ground cover increases the risk of accelerated erosion. The rate of increasing risk varies with ecosystem, with resilient environments having a slow rate of increase, and fragile environments having a rapid rate of increasing risk. The resultant method provides a way to assess watershed condition by comparing existing ground cover in relation to the potential ground cover the watershed can support, and that level of ground cover needed to limit the risk of triggering accelerated erosion and upward channel migration. In addition, it allows pratictioners to discern the decision space available and assess the sensitivity of environments they manage. (See also W87-05791) (Author's abstract)
W87-05808

ESTIMATING SEDIMENT DISCHARGE IN CANALS IN COLORADO,
Geological Survey, Lakewood, CO.
B. C. Ruddy.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 6-19 to 6-24, 1 fig, 2 tab, 4 ref.

Descriptors: *Sediment discharge, *Canals, *Colorado, *South Platte River, *Irrigation canals, Suspended sediments, Sediment concentration, Regression analysis, Mathematical analysis, Statistical analysis.

Suspended-sediment concentrations were measured at the South Platte River and at four sites on each of three nearby irrigation canals of the South Platte River in northeastern Colorado during 1982-83. Suspended sediment discharge was calculated and log linear-regression equations were developed at each site to estimate suspended sediment discharge when only water discharge is available. Analysis showed that the best estimate of suspended sediment discharge in the canals was made using the water discharge at each canal site and the water discharge in the South Platte River. Measured suspended sediment concentrations of the South Platte River were compared to measured suspended sediment concentrations at the upstream measurement site of each canal. The correlation coefficients indicated that suspended sediment concentrations in the South Platte River are highly related to the suspended sediment concentrations in the three canals and affect the suspended sediment inflow to the canals. (See also W87-05791) (Author's abstract)
W87-05809

SEDIMENT TRANSPORT CAPACITY OF FLOW IN RILLS AND SMALL CHANNELS,
Agricultural Research Service, Morris, MN.
R. A. Young, C. A. Onstad, and D. D. Bosch.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 6-25 to 6-33, 2 fig, 2 tab, 14 ref.

Descriptors: *Sediment transport, *Rills, *Channel flow, Mathematical equations, Particle size, Theoretical analysis, Mathematical analysis, Field tests.

A method of modifying currently used sediment transport equations to take into consideration differences in the availability of various particle size classes of sediment was developed using the concept of an effective transport efficiency. The modifications were based on theory, and tested with field and laboratory measurements of the transport of various sizes of sediment in different sized channels. A comparison of test results with values predicted by the unmodified transport equations indicates that the unmodified transport equation can seriously overestimate the amount of sediment transported in small channels. The proposed modifications greatly increased the accuracy with which the transport capacity for smaller sized particles was estimated. (See also W87-05791) (Author's abstract)
W87-05810

SEDIMENT ROUTING-AN ELECTRONIC SPREADSHEET TEMPLATE,
Soil Conservation Service, Davis, CO.
R. S. White.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 6-34 to 6-43, 1 fig, 7 ref, 2 append.

Descriptors: *Sediment transport, *Computer programs, *Mathematical model, Computers, Sediment distribution, Mathematical methods, Sediment yield, Sedimentation.

Sediment routing is a mathematical modeling technique that simulates deposition and transport of sediment within the stream channel and on the flood plain. Sediment routing involves numerous calculations. The spreadsheet program does the required calculations quicker and with less chance for a mathematical error. All these calculations need to be repeated if the initial distribution of sediment deposition in the channel or on the flood plain does not match observed or recorded distri-

butions. If the sediment must be rerouted to fit the alternative conditions better, only a few adjustments in the input data are required to produce the new output on the computer instead of doing all the calculations again by hand. Although the process of determining sediment yield by the routing techniques described in this paper require judgment, the model does indicate the sedimentation processes that can occur in the project area, where sedimentation might occur, and the relative severity of problems caused by sedimentation. (See also W87-05791) (Lantz-PTT)
W87-05811

VERIFICATION OF THE PRMS SEDIMENT-DISCHARGE MODEL,
Geological Survey, Harrisburg, PA.
L. A. Reed.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 6-44 to 6-54, 7 tab, 3 ref.

Descriptors: *Sediment discharge, *Model studies, *Rainfall-runoff relationships, *PRMS, Precipitation-Runoff Modeling System, Land use, Flow discharge, Pennsylvania, Statistical analysis, Sediment load, Sedimentation, Suspended sediment.

The Precipitation-Runoff Modeling System (PRMS) is a modular design modeling system designed to evaluate the impacts of various combinations of land use on basin hydrology. A subrouting, Unit Discharge, calculates water discharges and suspended sediment concentrations for storms. A modified Unit Discharge subrouting was calibrated and verified using rainfall, water discharge, and suspended sediment concentration data collected during 21 storms at a 4.2-acre surface coal mine that was being reclaimed. The mine is located in southwestern Pennsylvania, in Fayette County. Eleven storms were used for calibration, with ten storms used for verification of the subroutine. For the 11 storms used for calibration the standard error of estimate for water discharge was 0.0378 log units or about 9%, and the standard error of estimate for sediment load was 0.100 log units or about 23%. For the 10 storms used for verification the standard error of estimate of water discharge was 0.133 log units or about 31%, and the standard error of estimate of sediment load was 0.229 log units or about 55%. The particle-size distribution of the suspended sediment discharge from the Fayette County site was determined on samples collected on September 2, 1981 - a storm used for verification, and on August 8, 1982 - a storm used for calibration. The particle size distribution of suspended sediment calculated by the model was within about 10% of the measured values. (See also W87-05791) (Author's abstract)
W87-05812

APPLICATION OF STREAMTUBE COMPUTER MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-05813

SEDIMENT TRANSPORT AND RIVER SIMULATION MODEL,
Bureau of Reclamation, Denver, CO.
C. J. Orvis, and T. J. Randle.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 6-65 to 6-74, 5 fig, 18 ref.

Descriptors: *Sediment transport, *River flow, *Simulation analysis, *Model studies, STARS, Sediment Transport and River Simulation, Alluvial channels, Alluvial rivers, Flow discharge, Water temperature, Particle size, Sedimentation.

The U.S. Bureau of Reclamation STARS (Sediment Transport and River Simulation) model was developed to simulate mathematically the movement of water and sediment through alluvial river channels. The unique feature of this one-dimensional steady-state model is the use of streamtubes to vary the hydraulic and sediment transport characteristics across a cross section. This allows a more realistic representation of sediment movement. Data requirements for operation of the STARS model include hydraulic parameters such as cross section geometries, water discharges, stages, and temperatures, as well as the associated sediment parameters such as size gradations of the streambed and sediment supply to the study reach. Hydraulic and sediment transport routing schemes have been coupled in the STARS model to reasonably predict changes in the bed profile on the East Fork River in Wyoming. This is partly because the STARS one-dimensional river model is able to represent lateral variations in water and sediment movement through the use of streamtubes. Since the STARS model performed well in the highly variable sand and gravel beds of the East Fork River, it is expected to apply to a variety of other sand and gravel bed rivers. (See also W87-05791) (Lantz-PTT)
W87-05814

RUNOFF-SEDIMENT YIELD MODEL FOR SEMIARID REGIONS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
J. J. Stone, L. J. Lane, E. D. Shirley, and K. G. Renard.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 6-75 to 6-84, 3 fig, 2 tab, 14 ref.

Descriptors: *Semiarid lands, *Runoff, *Sediment yield, *Model studies, *Rainfall-runoff relationships, Mathematical models, Sensitivity analysis, Theoretical analysis, Simulation analysis, Sediment transport, Sedimentation.

Watershed or basin-scale models are distributed to account for spatial variations in rainfall, soils, vegetation, and land use, and to represent complex channel networks accurately. A distributed model, ARDBSN (Arid Basin), based on simplified equations approximating infiltration, runoff, erosion, and sediment transport is described. The development and structure of the model is briefly reviewed. Three extensive analyses are described and interpreted: (1) sensitivity analysis for the major model parameters, (2) model validation, and (3) example applications. Theoretical shortcomings illustrate the need for research on specific processes and model components. Strengths of the present model are used to show the necessity of including hydrologic simulation in the development of scientifically defensible range management research. There is a need for development of expert systems for 'front end' or parameter estimation/input file development in support of complex simulation models, and for output interpretation to summarize detailed simulation results. (See also W87-05791) (Author's abstract)
W87-05815

APPLICATION OF HEC-6 TO EPHEMERAL STREAMS,
Arizona State Univ., Tempe. Dept. of Civil Engineering.
P. F. Ruff, D. W. Dust, and M. T. Bowers.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 239-248, 6 fig, 6 tab, 9 ref.

Descriptors: *Ephemeral streams, *HEC-6, *Computer models, *Arizona, *Sedimentation, *Scour, Sediment deposition, Model studies, Flooding, Stream flow.

Three ephemeral streams (Rellito Creek, Aqua Fria River, and Salt River) in Arizona were studied to determine the applicability of computer model HEC-6 to quantify sediment scour and deposition in a stream channel. Two topographic maps, of before and after a flood or series of floods, were used for each stream study. The HEC-6 geometric data, consisting of stream bed elevations, etc., was obtained from the pre-flood(s) map; the hydrologic input data comprised discretized hydrograph(s) of the study period. The geometric output data, of stream bed elevations, etc., was compared with data from the post-flood(s) map. Geometric, sediment and hydrologic data development strategies are discussed. Two supplemental computer programs are presented that greatly facilitate the utilization of HEC-6. The results of the study indicate that HEC-6 can be a useful adjunct for the analysis of scour and deposition in streams when the assumptions of the program are rigorously observed. (See also W87-05791) (Author's abstract)
W87-05816

DEVELOPMENT AND APPLICATION OF A SEDIMENTATION MODELING SYSTEM,
Hydrologic Engineering Center, Davis, CA.
D. M. Gee.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 249-258, 3 fig, 15 ref.

Descriptors: *Sedimentation, *Computer models, *Data acquisition, *Data interpretation, Model studies, Computer programs, Channeling, Alluvial streams, HEC-6.

A study was performed to predict the long-term effects of a channelization project on an alluvial stream. Impacts within, upstream and downstream of the project were identified. The study methodology incorporated use of the movable boundary model, HEC-6. Application of HEC-6 to this study required development and manipulation of a large amount of hydrologic data. This paper focuses on the computer programs used to accomplish the study objectives. The application of predictive numerical models such as HEC-6 to project impact analyses is a valuable component of professional engineering. Planning of such a study should recognize the following points: (1) Support software (pre- and post-processors) is a vital ingredient. Therefore, it must be available, operational on the computer system, and the linkages between programs efficient; (2) Data storage, manipulation, and presentation are critical. In the study reported here, the hydrologic data (flow record) was by far the largest and most difficult to assemble data component; (3) Execution times/throughput. Many executions of the model are required to sanitize the data, calibrate, and study alternatives; selection of machine and consideration of run scheduling should be addressed in the study plan; (4) Graphics. Software and hardware compatibility must be ensured; and (5) Role of microcomputers. Operation of HEC-6 on microcomputers is not under consideration but use of microcomputers to assemble data, communicate with a host computer, display results, and manage the study effort is viable. (See also W87-05791) (Lantz-PTT)
W87-05817

MODELLING SEDIMENT YIELDS INTO STAMFORD LAKE, TEXAS,
Agricultural Research Service, Temple, TX.
J. G. Arnold, M. D. Bircket, J.. R. Williams, H. N. McGill, and W. F. Smith.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 259-269, 3 fig, 7 tab, 17 ref.

Descriptors: *Model studies, *Stamford Lake, *Sediment yield, *Texas, Computer models, HYMO, SWRRB, Hydrologic models, Sedimentation rates, Sedimentation, Simulation analysis, Reservoir silting.

The Soil Conservation Service (SCS) completed sediment surveys on Stamford Lake in May 1966 and September 1982. Stamford Lake watershed is a 932 sq km rural watershed in Haskell, Jones, and Stonewall counties. Two computer models, HYMO (HYdrologic MOdel) and SWRRB (Simulator for Water Resources in Rural Basins), were utilized to estimate average annual sediment rates and total volumes of deposition. Measured annual sediment yield was 6.1 t/ha, compared to 5.1 t/ha and 5.3 t/ha simulated by HYMO and SWRRB, respectively. An unusually intense storm (greater

than the 100-year storm) occurred on the Stamford Lake watershed on August 3-4, 1978. Simulation results show 21-26% of the sediment deposited in the reservoir from 1966 to 1982 occurred during this storm. (See also W87-05791) (Author's abstract)
W87-05818

SEDIMENT TRANSPORT SIMULATION IN AN ARMOURED STREAM,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
R. T. Milhous, J. B. Bradley, and C. L. Loeffler.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 270-280, 2 fig, 4 tab, 6 ref.

Descriptors: *Sediment transport, *Simulation analysis, *Armoured streams, *Mathematical studies, Mathematical equations, Channels, Model studies, Bed load, Gravel, Shear stress.

Improved methods of calculating bed material stability and transport must be developed for a gravel bed stream having an armoured surface in order to use the HEC-6 model to examine channel change. Good possibilities exist for use of a two layer model based on the Schoklitsch and the Einstein-Brown transport equations. However, data is needed on the armour and the bed material below the armour in order for the bed material data collected in a gravel bed stream to be useful in developing methods of calculating bed load in an armoured stream. Also, the Meyer-Peter, Muller equation should not be used in an armoured stream when the bed shear stress is relatively low because the results are most likely to be misleading. (See also W87-05791) (Lantz-PTT)
W87-05819

ALLUVIAL COMPUTATIONS IN COMPLEX RIVER NETWORKS,
Iowa Inst. of Hydraulic Research, Iowa City.
F. M. Holly, K. E. Schneider, and W. J. Mellema.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 281-290, 3 fig, 7 ref.

Descriptors: *Alluvial channels, *River networks, *Channel erosion, *Missouri River, Degradation, Computer models, Simulation analysis, IALLUVIAL, Computer programs, Research priorities.

Efforts to predict the future course of channel degradation in the Missouri River between Sioux City and Omaha have led to the development of IALLUVIAL, a compuer code for the simulation of long-term channel aggradation and degradation in non-uniform alluvium. IALLUVIAL has been successfully used to forecast a progressive slowing down of degradation in the next twenty years. The techniques used in IALLUVIAL have been incorporated in the new BRALLUVIAL code for braided or other multiply-connected channel systems. The techniques employed in IALLUVIAL, taken as a whole, have been validated to some extent with successful Missouri River simulations. However, these modelling results do not signal the end, but rather the beginning, of efforts to achieve a better physical understanding and mathematical formulation of constituent physical processes such as armoring, sorting, mixed-layer dynamics, mixed grain-and-form roughness, etc. There is an urgent need for imaginative comprehensive laboratory experiments on non-equilibrium bed evolution in channels having nonuniform bed sediments. (See also W87-05791) (Lantz-PTT)
W87-05820

OFFSITE SEDIMENT IMPACTS USING BASIN SCALE SIMULATION,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. D. Nicks, R. R. Schoof, and P. B. Allen.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 291-301, 5 fig, 3 tab, 7 ref.

Descriptors: *Sedimentation, *Simulation analysis, *River basins, *Environmental impact, *Winter Creek, *Little Washita River, *Oklahoma, Precipitation, Model studies, Runoff, Peak flow, Sediment load.

A basin-scale model (SWRRB) has been developed and tested that will simulate on a daily time step, runoff, peak flow, sediment load, soil water budget, pond and reservoir storage, and sediment budget. The model uses as data input, observed daily multiple gage rainfall, or simulated multiple or single-basin gage daily precipitations. Air temperature, and solar radiation inputs are also simulated on a daily basis. SWRRB was developed for a basin or watershed ranging in size from a few hectares to several thousand square kilometers. The present form of the model allows division of the basin into 5 sub-basin areas, and corresponding parameter inputs for each sub-area. It has been tested on the Winter Creek and Little Washita River basins in Oklahoma, with drainage areas of 538.2 and 88.25 sq km. These basins were divided into 4 and 3 sub-basins respectively representing different soils, covers, and topographies. Simulated results with and without a flood control project were made which show good correspondence between observed and computed basin responses. Major conclusions from the results are: (1) This basin-scale model can be used to evaluate the offsite impacts of flood control and conservation programs on large areas; and (2) It can be used with readily available data on ungaged basins. (See also W87-05791) (Lantz-PTT)
W87-05821

SELECTED FUNCTIONS FOR SEDIMENT-TRANSPORT MODELS,
Geological Survey, NSTL Station, MS.
D. H. Schoellhamer, and P. B. Curwick.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 311-320, 3 fig, 2 tab, 16 ref.

Descriptors: *Sediment transport, *Model studies, *Mississippi River, Computer programs, Model studies, Computer models, Flow profiles, Shear stress, Bed load.

Using data for the Mississippi River, several functions that describe the erosion and deposition processes of suspended sediment in rivers were analyzed. These erosion and deposition functions were programmed as subroutines of a one-dimensional Lagrangian transport model. Flow fields for transport modeling were generated using a one-dimensional flow model. The transport model was calibrated and verified with six sets of suspended sediment data collected from a 295.6-mile study reach of the lower Mississippi River. Shear stress functions and a reference equilibrium concentration function successfully modeled the suspended sediment, but a bed load layer dependence function was unsuccessful. This analysis will improve the modeler's ability to simulate suspended sediment transport for many practical applications. (See also W87-05791) (Author's abstract)
W87-05823

SMALL WATERSHED MODEL (SWAM),
Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 7A.
W87-05824

EVALUATION OF A ROAD SEDIMENT MODEL,
Idaho Univ., Moscow. Dept. of Civil Engineering.
F. J. Watts, E. R. Burroughs, J. G. King, and D. Hansen.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. II, 1986. Volume II. p 325-334, 6 fig, 1 tab, 1 ref.

Descriptors: *Sedimentation, *Model studies, *Roads, *Runoff, *Sediment yield, Performance evaluation, Simulated rainfall, Slopes, Sampling, Sensitivity analysis.

The yield and gradation of sediment that resulted from a 1-inch simulated rainfall on unsurfaced roadways were compared to the yield and gradation of sediment predicted by a physical process model, ROSED. The precipitation was applied in 23-30 minutes on three separate plots. Plot lengths ranged from 50 to 100-ft long with widths of 13-17 ft. Cross slopes ranged from 2 to 4% and longitudinal slopes ranged from 6% to 9%. The unsurfaced roadways were constructed of 'border zone' soils and were located in the Boise and Nezperce National Forests. A modified Colorado State University Rainulator was used to apply the precipitation. The runoff from each plot was measured using a flume with stilling well and flowmeter. Grab samples were obtained at one minute intervals to determine sediment yield and to collect adequate sediment for gradation analysis. A sensitivity analysis was performed on each of the parameters that affects the yield and gradation of sediment. Important elements for predicting sediment in the ROSED model are raindrop detachment, sediment detachment by overland flow, and sediment transport by overland flow. Each parameter in a sample data set was systematically varied to determine the effect the parameter has on model output. Known soil properties, geometry and rainfall data for each plot were then used for input and the model was calibrated to obtain output that closely matched the sediment yield and gradation observed in the field. Sediment input parameters that produced the greatest change in model output for sediment yield and gradation were parameters used for computing bed load transport within the model. Using a set of proposed sediment input parameters based on known soil characteristics and known site data, without calibration, the model predicted sediment yields that were within + or - 50% of the actual yield. With calibration the model predicted sediment yields within + or - 1% of the actual yields. The grain size distribution curves and sediment graphs also closely matched measured curves. (See also W87-05791) (Author's abstract)
W87-05825

MOVEMENT OF DREDGED SAND AT THALWEG DISPOSAL SITES,
Argonne National Lab., IL. Energy and Environmental Systems Div.
J. D. Ditmars, D. L. McCown, and R. A. Paddock.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 337-346, 5 fig, 7 ref.

Descriptors: *Thalweg, *Disposal sites, *Dredging, *Sand, *Sediment transport, Mississippi River, Channel improvement, Channels.

Thalweg disposal experiments have been conducted with the U.S. Army Corps of Engineers, Rock Island District, at three sites on the Upper Mississippi River. During normal maintenance, hydraulically dredged sand was tagged with sand coated with fluorescent dye prior to disposal as a pile in the thalweg. In postdisposal surveys surficial bottom sediment samples were collected in the disposal area and in the thalweg and border areas downstream to determine the movement of the dredged sand relative to environmentally sensitive river habitats. The experiments were initiated in successive years, and the tagged sand has been tracked for 1-3 years depending on the site. Although the downstream movement of the dredged sand was not the same at each site, the general pattern of behavior was similar. Downstream movement was confined primarily to the main channel and occurred in response to periods of high river discharge. There was no statistically significant evidence of dredged sand dispersing out of the main chanenl into nearby border areas or sloughs. The distributions of dyed sand in cores from one site suggest that the dredged sand has been incorporated into natural bed forms. (See also W87-05791) (Author's abstract)
W87-05826

SEDIMENT-NUTRIENT TRANSPORT IN AGRICULTURAL RUNOFF,

Agricultural Research Service, Durant, OK.
S. J. Smith, A. N. Sharpley, J. R. Williams, A. D. Nicks, and O. R. Jones.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 347-356, 2 fig, 2 tab, 15 ref.

Descriptors: *Sediment transport, *Nutrients, *Agricultural runoff, Model studies, Mathematical models, Phosphorus, Nitrogen, Soil loss.

Accurate predictions of sediment and associated nutrient transport are important from land use, management, and environmental standpoints. To predict sediment yield for individual runoff events the Modified Universal Soil Loss Equation (MUSLE) was employed for 23 grassed and cropped watersheds in the Southern Plains over study periods of 3 to 5 years. Use of MUSLE involved both measured and computed runoff energy factors. Corresponding losses of soluble P were predicted using a soil P desorption equation, and particulate P and N losses were predicted using a relationship between enrichment ratio (nutrient content of sediment/source soil) and soil loss. In general, the results indicate that MUSLE and the nutrient equations provided realistic estimates of sediment and nutrient transport in runoff. (See also W87-05791) (Author's abstract)
W87-05827

POLYCHLORINATED BIPHENYLS IN THE HOUSATONIC RIVER,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-05829

SEDIMENT/FISH MODELING IN THE SOUTH FORK SALMON RIVER,
Fayette National Forest, McCall, ID.
For primary bibliographic entry see Field 4C.
W87-05830

BENTHOS IN A SEDIMENT-LADEN DELTA STREAM SYSTEM,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
C. M. Cooper.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 387-396, 2 fig, 2 tab, 14 ref.

Descriptors: *Water pollution effects, *Sediments, *Bear Creek, *Deltas, *Benthos, *Mississippi, Chaoborus, Chironomidae, Oligochaeta, Bryozoa, Mollusks, Hirudinea, Crustaceans.

The macroinvertebrate fauna of Bear Creek, a 83-km stream which flows through 6 oxbow lakes, was studied for 2 years. Two off-stream lakes in the same watershed were also investigated. Bear Creek, a tributary of the Yazoo River in the Delta region of Mississippi, drains 330 sq km of intensively cultivated agricultural land and carries a continuing sediment concentration during the rainy season of up to 1300 mg/L. Benthic organisms were collected monthly from August, 1976 through August, 1978 at 6 stream stations and at 14 lake stations, across a variety of substrates, and at depths ranging from 0.5 m to 6.5 m. In most lake and stream sections of the creek, Chaoborus (1 species), Chironomidae (19 genera), and Oligochaeta (3 species), dominated the benthos. Thirteen other genera of insects were represented as were Bryozoa (4 genera), Mollusca (9 genera), Hirudinea (5 genera), and Crustacea (3 genera). There was continuous stress from high rates of sedimentation (up to 7 cm/yr) as indicated by diversity at a majority of the lake stations. Creek stations were subject not only to heavy sedimentation but also to fluctuations in water level and drying. A low standing crop of benthos in areas affected most by sediments and limited species diversity in potentially productive areas indicated a stressed aquatic environment. Invertebrate production from an abundance of snag habitat was significant at most creek sites. The mayfly Hexagenia bilineata, the clam Sphaerium rhomboideum, and the bryozoan Pectinatella magnifica, indicated significant negative responses to high suspended sediment concentrations and accompanying pollutants. (See also W87-05791) (Author's abstract)
W87-05831

BUDGET ANALYSIS OF TURBIDITY AND STREAMFLOW DATA,
Umpqua National Forest, Roseburg, OR.
For primary bibliographic entry see Field 6G.
W87-05833

ENVIRONMENTAL ASPECTS OF SEDIMENTATION,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
T. A. Burke.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 416-420, 5 ref.

Descriptors: *Sedimentation, *Water pollution effects, *Environmental effects, *Colorado River, *Arizona, Parker, Dams, Sediment transport, Degradation, Bed load, Sediment load, Aquatic life, Stream biota.

Historically, the lower Colorado River annually transported over 180 million tons of sediment through the Parker Division, near Parker, Arizona. Since closure of mainstream dams, less than 2 million tons of sediment are transported out of the Parker Division each year. This present sediment load originates within the Parker Division due to lateral bank cutting and streambed degradation. Whereas the native aquatic community (under heavy sediment loads) was rather limited, the change in sediment transport has allowed a diverse, although exotic, aquatic community to develop. (See also W87-05791) (Author's abstract)
W87-05834

PHYSICAL PROPERTIES OF ERODED SEDIMENT,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. D. Meyer, F. E. Rhoton, and L. L. McDowell.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 423-431, 2 fig, 2 tab, 23 ref.

Descriptors: *Sediments, *Physical properties, *Erosion, Sediment distribution, Particle size, Sediment transport, Sediment discharge, Aggregates, Clays, Rills, Silt, Sand, Soil texture.

Sediment properties such as size distribution, density, and stability can greatly affect sediment transport and deposition. Sediment eroded from agricultural soils consists of primary sand, silt, and clay plus less-dense aggregates of these soil separates. Sediment size distributions vary widely among soils due to soil texture, aggregation, stability, and land use. Erosion of fine-textured soils often produces coarse sediment because much of the eroded material is in the form of large, stable aggregates that contain a high percentage of clay particles. Sediment from rills is generally coarser than that from interrill areas. Knowledge acquired during field research was used to develop laboratory methods for predicting and further characterizing sediment properties. A procedure was developed to predict sediment size distributions using bulk samples of surface soil. Eroding aggregates had a density of about 2.0 g/cu cm. Aggregates eroded by raindrop impact were stable during transport by runoff. Knowledge of sediment properties is necessary for the development of predictive equations and models to describe the transport of eroded sediment. (See also W87-05791) (Author's abstract)
W87-05835

SEDIMENT PARTICLE SIZES FROM LOW SLOPES,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and L. L. McDowell.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 432-438, 2 fig, 4 tab, 7 ref.

Descriptors: *Particle size, *Slopes, *Sediments, *Statistical analysis, Runoff, Model studies, Statistical models, Clays, Aggregates, Sediment distribution.

Knowledge of sediment sizes in runoff is needed to model the soil erosion process. Using simulated rainfall, this study determined sediment sizes from different slope lengths on a 0.2% slope. No statistical difference due to time during the storm, plot length, or dry and wet runs could be found in sediment size distributions from the plots. Enrichment ratios of sediments ranged from 1.4 for clay to 0.1 for sand. More than 70% of the sediment clay was transported in aggregates; median particle diameter (D sub 50) sizes of the nondispersed sediment were 2 to 3 times as large as D sub 50 of the dispersed sediment. (See also W87-05791) (Author's abstract)
W87-05836

CHEMICALS ASSOCIATED WITH LOWER MISSISSIPPI RIVER SEDIMENTS,
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. R. Demas, and P. B. Curwick.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 439-448, 4 fig, 1 tab, 18 ref.

Descriptors: *Mississippi River, *River sediments, *Chemicals, *Path of pollutants, *Statistical analysis, Sampling, Suspended sediments, Volatile organics, Organic compounds, Particle size, Manganese, Iron, Cobalt, Chromium, Aluminum, Copper, Cadmium, Nickel, Zinc, Heavy metals.

Chemical-quality and sediment data collected from December 1982 to February 1985 at six sites on the lower Mississippi River were analyzed statistically. Results showed strong linear correlations ($r >$ or $=$ to 0.7) between concentration of fines and total recoverable and suspended manganese, iron, and cobalt in whole water samples. Strong linear correlations ($r >$ or $=$ to 0.7) were not found for sand or the < 4 and <2 microns soze distribution. Analyses of three distinct suspended sediment particle size classes confirmed these observations for manganese, iron, and cobalt and also showed increasing minor element concentration with decreasing suspended sediment particle size for aluminum, chromium, copper, cadmium, nickel, and zinc. Data indicate that manganese and iron oxide coatings may play a significant role in the transport of minor elements by the lower Mississippi River. Therefore, impact of minor elements on wetlands receiving Mississippi River water can be minimized by restricting diversion of Mississippi River water during rising stages when suspended sediment concentrations are highest and permitting diversions during falling stages when suspended sediment concentrations are lower. (See also W87-05791) (Lantz-PTT)
W87-05837

CCA AND PCP IN CONTAMINATED FOREST STREAM SEDIMENTS,
Southeastern Forest Experiment Station, Gainesville, FL.
For primary bibliographic entry see Field 5B.
W87-05838

ROLE OF SEDIMENT IN ACCELERATED EUTROPHICATION,
Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 5C.
W87-05839

NUTRIENT-SEDIMENT RELATIONS IN STREAMFLOW,
Geological Survey, Reston, VA.

For primary bibliographic entry see Field 5B.
W87-05840

NUTRIENT TRANSPORT BY SEDIMENT FROM PINE FORESTS,
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
P. D. Duffy, J. D. Schreiber, and S. J. Ursic.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 479-487, 3 tab, 9 ref.

Descriptors: *Sediment transport, *Nutrients, *Forest watersheds, *Mississippi, Phosphorus, Nitrogen, Pine trees, Forestry, Water quality, Forest management, Sediment distribution.

Sediment transport of phosphorus (P) and nitrogen (N) was quantified from two small catchment studies in the upper Coastal Plain. A study in north Mississippi included five catchments (1.5 to 2.8 ha) of undisturbed loblolly (Pinus taeda L.) and slash (Pinus elliottii Engelm.) pine plantations. Of 15 catchments (0.2 to 0.6 ha) in a west Tennessee study, 4 were undisturbed pine, 8 clearcut and replanted with pine, and 3 were stripcut with natural regeneration. Sediment P and N concentrations and yields were related to soil, sediment, and stormflow characteristics. These catchments of pine protect water quality and maintain site productivity by yielding only small amounts of sediment and associated nutrients. However, 40% or more of the N and 70% or more of the P in stormflow were transported by sediment, demonstrating the need to maintain low sediment yields. (See also W87-05791) (Author's abstract)
W87-05841

WATER QUALITY IMPACTS FROM SEDIMENT IN THE SOUTHEAST,
Tennessee Valley Authority, Knoxville, TN. Environmental Quality Staff.
For primary bibliographic entry see Field 5C.
W87-05842

CONCENTRATION DISTRIBUTION OF SEDIMENT MIXTURES IN OPEN-CHANNEL FLOW,
Karnataka Regional Engineering Coll., Suratkal (India). Dept. of Civil Engineering.
B. R. Samaga, K. G. R. Raju, and R. J. Garde.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 5, p 467-483, 1985. 16 fig, 2 tab, 13 ref.

Descriptors: *Channel flow, *Suspended sediments, *Model studies, *Sediment distribution, *Sediment concentration, *Vertical distribution, Hydraulic models, Rouse's equation, Rhine River, Rio Grande River, Performance evaluation, Sediments.

A series of experiments were conducted using non-uniform sediments involving the measurements of velocity and concentration distribution of individual size fractions. Rouse's equation and others for concentration distribution of flow in an open channel were checked for their accuracy with the help of data of suspended-sediment concentration-distribution of the individual fractions in a mixture. The agreement between predictions and measurements was unsatisfactory. It was found that the sediment distribution exponent for any size in the mixture is not constant over the whole depth of flow. A two-layer model is suggested to describe the vertical sediment distribution. A predictor for the reference concentration at 0.2D is also suggested. The model showed satisfactory agreement with the measurements on the Rhine River and the Middle Rio Grande River. (McFarlane-PTT)
W87-05857

FOSSIL SOILS AS GROUNDS FOR INTERPRETING LONG-TERM CONTROLS ON ANCIENT RIVERS,
Oregon Univ., Eugene. Dept. of Geology.
G. J. Retallack.
Journal of Sedimentary Petrology JSEPAK, Vol. 56, No. 1, p 1-18, January 1986. 13 fig, 1 tab, 82 ref. NSF Grant EAR 8206183.

Descriptors: *Rivers, *History, *Paleohydrology, *Soil dynamics, *Soil genesis, *Fossil soils, Soil environment, Soil surfaces, Fluvial sediments, Drainage area, Episodic sedimentation, Erosion, Erosion rates, Badlands National Park.

The main factors controlling fluvial systems are time, initial topographic relief, geology, climate, vegetation, base level, upland runoff, upland drainage network, hillslope morphology, downstream deliveries, channel behavior, and pattern of deposition. Similar factors control soil formation in drainage basins: climate, organisms, topographic relief, parent material, and time. Former rainfall may be interpreted from depth to the top of calcic horizon, from percent clay, from percent of different kinds of clay minerals, from quartz/feldspar ratio, from hue, and from identification of fossil soils. Interpretation of the role of these factors in producing a particular stratigraphic section should take into account its resolution: the proportion of geological time represented (temporal completeness), of original sediment preserved (lithological completeness), and of original fossils preserved (paleotological completeness). Temporal and lithological completeness can be estimated by comparison with the most likely rates of sediment accumulation and most likely thicknesses (respectively) for pertinent sedimentary environments and time scales. Paleontological completeness can be estimated by comparing the preserved fossils with expectations based on former ecosystems indicated by fossil soils. Likely controls and resolution of a sequence of Eocene and Oligocene fossil soils from Badlands National Park, South Dakota, were studied as a guide to the periodicity and causes of episodic sedimentation there. Short-term episodicity and filtering of sedimentation events of a particular magnitude were apparent from superposition of paleosols, but resolution of the sequence was not sufficient to permit a detailed analysis of their individual causes. Long-term paleoenvironmental changes and four episodes of erosional downcutting could be recognized. All four occasions of landscape instability and erosion were times of drier climate and sparser vegetation than usual. Local uplift and supply of volcanic ash were contributing factors in some episodes of erosion. When allowances are made for time scales and completeness of sequences of fossil soils, they can be useful indicators of changes in former environment, biota, and fluvial regime. (Author's abstract)
W87-05858

BIOGENIC EFFECTS ON DEVELOPMENT OF MAGNETIC FABRICS IN COASTAL GEORGIA SEDIMENTS,
Georgia Univ., Athens. Dept. of Geology.
For primary bibliographic entry see Field 2L.
W87-05859

DEPTH-INTEGRATED MODEL FOR SUSPENDED SEDIMENT TRANSPORT,
Technische Hogeschool Delft (Netherlands).
G. Galappatti, and C. B. Vreugdenhil.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 4, p 359-377, 1985. 8 fig, 6 ref, append.

Descriptors: *Sediment transport, *Model studies, *Silting, *Suspended sediments, Vertical distribution, Hydraulic models, Dredging, Transport, Rivers, Estuaries, Dispersion, Model testing.

The process of suspended sediment transport in rivers and estuaries is a three-dimensional one. Some models were derived which take the vertical direction explicitly into account by considering a 2-d vertical plane. This paper analyzes the possibility of using the concept of dispersion through depth integration for suspended sediment. A model for suspended sediment transport in unsteady and non-uniform flow is derived, in which the vertical dimension is eliminated by means of an asymptotic solution. The resulting depth-integrated model is tested for unidirectional flow cases and an application to the siltation of a dredged channel is given. This solution will bridge the gap between the depth-averaged solutions and the full two-dimensional solutions. The symptotic approach yields equations that can be written in terms of depth-averaged quantities and has the potential for extension to a third dimension. An indirect test was made, with reasonable success, by reproducing an experiment for the siltation of a trench. (McFarlane-PTT)
W87-05861

EFFECTS OF SEDIMENTATION ON REMOVAL OF FAECAL COLIFORM BACTERIA FROM EFFLUENTS IN ESTUARINE WATER,
Clyde River Purification Board, East Kilbride (Scotland).
D. P. Milne, J. C. Curran, and L. Wilson.
Water Research WATRAG, Vol. 20, No. 12, p 1493-1496, December 1986. 2 fig, 12 ref.

Descriptors: *Sedimentation, *Adsorption, *Path of pollutants, *Coliforms, *Deposition, *Suspended solids, *Estuaries, Bioindicators, Mathematical models, Water treatment, Bacteria, Effluents.

Under laboratory conditions, the deposition rates of fecal coliform bacteria with estuary-type suspended solids were studied. Natural estuarine water samples and their bacteria formed one system, and sewage final effluent and related bacteria, mixed with seawater, formed a second. The results will help quantify one parameter in a mathematical model of bacterial pollution presently being developed by the Clyde River Purification Board (Scotland). Fecal coliform deposition rates in estuary water increased proportionately with suspended solids concentration, whereas deposition rates in the effluent/seawater mixture showed no such correlation. Deposition of estuary water suspended solids correlated with time, while effluent suspended solids showed no correlation. The adsorption efficiency experiments suggested immediate adsorption of some of the fecal coliforms onto both types of suspended solids and no difference in adsorption potential. Therefore, it appears that the contrasting effects on fecal coliform deposition can be attributed to the different deposition potential of each type of suspended solids and not to the adsorption process. (Airone-PTT)
W87-05906

2K. Chemical Processes

CONCEPTUAL MODELS OF GEOLOGIC AND AGRICULTURAL SALT LOADS IN STREAMS OF THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5B.
W87-05185

CHEMICAL REACTIONS INFLUENCING SALINITY INCREASE OF SOIL AND GROUNDWATERS IN THE GREAT BASIN, WESTERN UNITED STATES,
Nevada Univ. System, Reno. Water Resources Center.
B. Bohm, and R. L. Jacobson.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 525-534, 4 fig, 20 ref.

Descriptors: *Chemical reactions, *Salinity, *Soil salinity, *Groundwater pollution, *Great Basin, *Water pollution sources, Silicates, Nevada, Chlorides, Carbonates, Calcium, Magnesium, Sulfates, Sodium, Potassium, Groundwater movement, Cations.

The controls on major cation and anion levels in cold and thermal groundwaters in a semi-arid environment are demonstrated, using 1040 data sets from central and western Nevada. The area studied contains mostly paleozoic, mesozoic and cenozoic silicate rocks. The waters were classified by chloride content assuming that chloride levels increase along a groundwater flow path. The effects of rock dissolution and formation of secondary silicate and carbonate minerals are evaluated. It is concluded that the groundwater chemistry is

mostly controlled by common processes of rock dissolution and formation of secondary minerals. The major cations and silica are provided from dissolution of silicate minerals. Levels of Ca, Mg, SO4 and alkalinity are mostly controlled by the formation of carbonate and sulfate minerals, whereas Na, K, and Si)2 are mostly controlled by incongruent silicate reactions. Chloride is derived from traces in rocks and only minimally from cyclic salts. It increases gradually along a flow path and due to the high solubility of its salts, its levels are not restricted. The acidity required for the advance of rock dissolution is probably mostly provided by CO2 derived from geothermal processes, and to a lesser extent from biological activity in soils and perhaps locally from the oxidation of sulfide minerals. (See also W87-05165) (Lantz-PTT)
W87-05214

LAKE BROKOPONDO: FILLING PHASE LIMNOLOGY OF A MAN-MADE LAKE IN THE HUMID TROPICS,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
For primary bibliographic entry see Field 2H.
W87-05255

ACIDITY OF DEW,
Ford Motor Co., Dearborn, MI.
For primary bibliographic entry see Field 5B.
W87-05340

POSSIBLE ROLE OF NO3 IN THE NIGHTTIME CHEMISTRY OF A CLOUD,
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
For primary bibliographic entry see Field 5B.
W87-05341

LONG-RANGE TRANSPORT AND DEPOSITION OF ACIDIC NITROGEN SPECIES IN NORTH-WEST EUROPE,
UKAEA Atomic Energy Research Establishment, Harwell (England). Modelling and Assessments Group.
For primary bibliographic entry see Field 5B.
W87-05352

ACID RAIN: STATES PROD EPA; ACID DEPOSITION STUDY,
For primary bibliographic entry see Field 6E.
W87-05359

ISOLATION OF HALOTOLERANT THERMUS SPP. FROM SUBMARINE HOT SPRINGS IN ICELAND,
Iceland Univ., Reykjavik. Biological Inst.
J. K. Kristjansson, G. O. Hreggvidsson, and G. A. Alfredsson.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1313-1316, December 1986. 2 fig, 2 tab, 18 ref.

Descriptors: *Salt tolerance, *Aerobic bacteria, *Hot springs, *Isolation, *Bacterial growth, *Salinity, Iceland, Thermus spp.

Since the isolation by Stetter of bacteria capable of growing at 110 C from a submarine solfatara field in Italy and the discovery of life associated with the deep-sea hydrothermal vents in the Pacific, there has been a greatly increased interest in the biology of submarine hot springs. The deep-sea vents are a continuous source of highly reduced compounds, like H2S and H2, which serve as substrates for chemosynthetic bacteria. These bacteria are therefore the main primary producers in this deep-sea ecosystem and in fact support extensive populations of certain invertebrates. Thermophilic, aerobic bacteria of the genus Thermus were isolated from submarine alkaline hot springs in Iceland. Five submarine hot springs were sampled, and all had viable counts of Thermus spp. of about <1000 CFU/ml. All submarine strains grew in the presence of NaCl at 3% or higher, but no strains from terrestrial hot springs would grow at concentrations higher than 1% NaCl. The growth rate of submarine Thermus strains was not stimulated by NaCl and was reduced at NaCl concentrations higher than 1%. The pattern of growth of these isolates on single carbon sources was similar to that of terrestrial isolates. (Alexander-PTT)
W87-05396

WATER CHEMISTRY IN CHANGING TIMES: SIXTY YEARS OF THE WATER CHEMISTRY DIVISION OF THE GERMAN CHEMICAL SOCIETY (WASSERCHEMIE IM WANDEL DER ZEITEN: 60 JAHRE FACHGRUPPE WASSERCHEMIE IN DER GESELLSCHAFT DEUTSCHER CHEMIKER),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
K.-E. Quentin.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 4, p 127-132, August 1986. 18 ref.

Descriptors: *Water properties, *Chemical properties, *History, *Literature reviews, Research priorities, German Chemical Society, Legal aspects, Legislation, Environmental protection, Environment.

The sixty-year history reflects a tremendous development in water science. The important steps are described and explained using typical examples. They cover examination and evaluation of the topics of research and the transfer of the results into legislation. The prospect of water science and technology focuses mainly on the needs of environmental protection. (Author's abstract)
W87-05454

HEXACHLOROBENZENE, OCTACHLOROSTYRENE AND OTHER ORGANOCHLORINE COMPOUNDS IN WASTE WATER FROM INDUSTRIAL HIGH-TEMPERATURE PROCESSES INVOLVING CHLORINE,
For primary bibliographic entry see Field 5B.
W87-05456

SORPTION OF CHROMIUM(VI) ON HYDROUS IRON OXIDES,
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
S. Music, M. Ristic, and M. Tonkovic.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 5, p 186-188,193-196, October 1986. 9 fig, 2 tab, 47 ref.

Descriptors: *Wastewater treatment, *Water pollution effects, *Chromium, *Heavy metals, *Iron oxides, *Sorption, Iron, Iron compounds, Chemical reactions, Ions, Anions, Molybdenum, Hydrogen ion concentration, Spectrophotometry.

Amorphous Fe(OH)3, alpha-Fe2O3 and Fe3O4 were selected as model sorbents for Cr(VI) due to their controlling role in the distribution of heavy metal pollutants in natural systems and because Fe(OH)3 has already been used in the treatment of Cr(VI) wastewaters. The pH-dependence, the time dependence and the influence of different inorganic ions on the sorption of Cr(VI) were determined. The possible mechanism of the sorption of Cr(VI) on hydrous iron oxides was elucidated. Infrared spectroscopy was used to show the existence of chemical interactions between CrO4(2-) and the surface of hydrous iron(III) oxide. Chloride, sulfate and molybdate anions were chosen to investigate the competition with chromates for the sorption sites. The influence of molybdates on the sorption of chromates was the most pronounced. The sorption behavior of CrO4(2-) on Fe3O4 was explained by the reduction of traces of chromium(VI) at the magnetite/H2O interface. (Wood-PTT)
W87-05462

GEOCHEMISTRY OF TRACE METALS IN THE BRAZOS RIVER ESTUARY,
Texas A and M Univ., College Station. Dept. of Chemistry.
For primary bibliographic entry see Field 2L.
W87-05488

ELECTROCHEMICAL STUDY OF THE SPECIATION OF COPPER, ZINC AND IRON IN TWO ESTUARIES IN ENGLAND,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W87-05489

GAS-PHASE REACTION OF THE METHYLPEROXY RADICAL WITH SULPHUR DIOXIDE,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
A. T. Cocks, R. P. Fernando, and I. S. Fletcher.
Atmospheric Environment ATENBP, Vol. 20, No. 12, p 2359-2366, December 1986. 1 fig, 6 tab, 29 ref.

Descriptors: *Path of pollutants, *Acid rain, *Water pollution sources, *Sulfur dioxide, *Kinetics, *Photolysis, *Simulations, *Chemical reactions, *Methylperoxy radical, Computers, Chemistry, Atmospheric chemistry.

The kinetics of the reaction of methylperoxy with SO2 at 298 K were studied by monitoring the loss of SO2 during photolysis of SO2/azomethane/O2 mixtures. This reaction may be formally rationalized in terms of a reversible addition followed by a further reaction with methylperoxy. The ratio of rate constants is about 0.013/ppm/sec. It is estimated that this reaction is unimportant in the production of acidic sulfate from SO2 in the troposphere. Brief studies of the azomethane/O2 photolysis system suggest that the rate constant for the reaction of the methoxy radical with formaldehyde may be substantially higher than hitherto estimated, with a value of about 30 ppm/sec (approximately 1 x 10 to the minus 12th power cu cm/molecule/sec). Computer simulations of the SO2/azomethane/O2 system indicate that the rate constant for the reaction of methoxy with SO2 is <0.3/ppm/sec (approximately 1 x 10 to the minus 14th power/cu cm/molecule/sec). (Author's abstract)
W87-05541

FUTURE OF LABORATORY RESEARCH AND FACILITIES FOR CLOUD PHYSICS AND CLOUD CHEMISTRY,
Toronto Univ. (Ontario). Dept. of Physics.
For primary bibliographic entry see Field 2B.
W87-05547

AQUEOUS GEOCHEMISTRY AND DIAGENESIS IN THE EASTERN SNAKE RIVER PLAIN AQUIFER SYSTEM, IDAHO,
Geological Survey, Reston, VA.
W. W. Wood, and W. H. Low.
Geological Society of America Bulletin BUGMA, Vol. 97, No. 12, p 1456-1466, December 1986. 6 fig, 11 tab, 40 ref.

Descriptors: *Groundwater, *Rivers, *Aquifers, *Diagenesis, *Sedimentation, *Sediments, *Solutes, *Weathering, *Isotopes, Hydrologic budget, Snake River Plain, Idaho, Meteoric water, Calcite, Silica, Thermodynamics.

Water budget and isotopic analysis of water in the eastern Snake River Plain aquifer system confirm that most, if not all, of the water is local meteoric in origin. Solute mass-balance arguments suggest that approximately 5 times 10 to the 9th power moles of silica and 2.6 times 10 to the 9th power moles of silica are precipitated annually in the aquifer. Isotopic evaluations of calcite and petrographic observation of silica support the low-temperature origin of these deposits. Proposed weathering reactions are shown to be consistent with mass balance, carbon isotopes, observed mineralogy, and chemical thermodynamics. Large quantities of sodium, chloride, and sulfate are being removed from the system by solution relative to their abundances in the rock. Sedimentary interbeds, which are estimated to compose < 10% of the aquifer volume, may yield as much as 20% of the solutes generated within the aquifer. Weathering

rate of the aquifer framework of the eastern Snake River Plain is 14 (Mg/sq km)/yr or less than half the average of the North American continent. This contrasts with the rate for the eastern Snake River basin, 34 (Mg/sq km)/yr, which is almost identical to the average for the North American continent. Identification and quantification of reactions controlling solute concentrations in groundwater in the eastern plain indicate that the aquifer is not an inert bathtub that simply stores and transmits water and solutes, but is undergoing active diagenesis and is both a source and sink for solutes. (Author's abstract)
W87-05600

SPRING-RELATED CARBONATE ROCKS, MG CLAYS, AND ASSOCIATED MINERALS IN PLIOCENE DEPOSITS OF THE AMARGOSA DESERT, NEVADA AND CALIFORNIA,
Illinois Univ. at Urbana-Champaign. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W87-05602

CONDITIONAL STABILITY CONSTANTS AND BINDING CAPACITIES FOR COPPER (II) BY DISSOLVED ORGANIC CARBON ISOLATED FROM SURFACE WATERS OF THE SOUTHEASTERN UNITED STATES,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W87-05651

WATER AND SOLUTE MOVEMENT IN A HEAVY CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W87-05696

ANALYSIS OF SOLUTE MOVEMENT IN STRUCTURED SOILS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W87-05697

SALT TRANSPORT IN HEAVY CLAY SOIL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 5B.
W87-05698

EFFECT OF ANION EXCLUSION ON SOLUTE TRANSPORT IN SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 5B.
W87-05699

EVALUATING A MODEL FOR NITRATE LEACHING IN CLAY SOILS WITH MACROPORES,
Oxford Univ. (England). Dept. of Agricultural Science.
For primary bibliographic entry see Field 5B.
W87-05700

TRANSPORT OF SOLUTE IN HIGHLY STRUCTURED SOILS,
Laboratorium voor Grondmechanica, Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W87-05702

DENITRIFICATION IN GROUNDWATERS, PRINCIPLES AND METHODS FOR ITS IDENTIFICATION: A REVIEW (LA DENITRIFICATION DANS LES EAUX SOUTERRAINES, PRINCIPES ET METHODES DE SON IDENTIFICATION: UNE REVUE),
Paris-6 Univ. (France). Lab. de Biogeochmie des Isotopes Stables.
For primary bibliographic entry see Field 5A.
W87-05843

STUDY OF THE EARLY HYDRATION OF PORTLAND CEMENT,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8F.
W87-05865

QUANTITATIVE EXTRACTION AND CONCENTRATION OF SYNTHETIC WATER-SOLUBLE ACID DYES FROM AQUEOUS MEDIA USING A QUININE-CHLOROFORM SOLUTION,
Tokyo Coll. of Pharmacy (Japan). Lab. of Drug Metabolism and Toxicology.
For primary bibliographic entry see Field 7B.
W87-05881

PRECONCENTRATION OF TRACE ELEMENTS FROM AQUEOUS SOLUTIONS BY OSMOSIS,
Missouri Univ.-Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W87-05882

POLAROGRAPHIC STUDY OF THE INTERACTION BETWEEN HUMIC ACIDS AND OTHER SURFACE-ACTIVE ORGANICS IN RIVER WATERS,
Otago Univ., Dunedin (New Zealand). Dept. of Chemistry.
K. A. Hunter, and K. C. Lee.
Water Research WATRAG, Vol. 20, No. 12, p 1489-1491, December 1986. 2 fig, 1 tab, 16 ref.

Descriptors: *Polarographic analysis, *Surfactants, *Humic acids, *Rivers, Riparian waters, Estuaries, Fluorescence, Organic compounds, Spectral analysis, Adsorption, Accumulation.

Surface-active organic substances of both natural and synthetic origin occur in natural waters and are important because of their influence on interfacial processes involving colloids and suspended solids. The surface activity of river water humic acids (HA) was studied using the principle of suppression of polarographic streaming maxima by organics that absorb on the mercury electrode. HA isolated from river water by hydrophobic adsorption onto Amberlite XAD-2 were found to be almost four times more effective at maximum suppression than natural river water organics as a whole. UV and fluorescence measurements indicated that 25-30% of total dissolved organics were in the hydrophobic HA fraction. HA's were found to interact interfacially with other more hydrophilic organic components with a 50% decrease in their surface activity. Similar interactions were found with synthetic surface-active materials. Association of organic pollutants with HA may lead to significant accumulation in estuarine sediments and availability to filter-feeding organisms. The interactions exhibited by HA may have implications for measurement of other properties of surface-active organics and of HA as well (adsorption of HA by oxide surfaces, metal complexation properties). (Airone-PTT)
W87-05905

INTERACTIONS OF HUMIC ACIDS AND ALUMINUM SALTS IN THE FLOCCULATION PROCESS,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
For primary bibliographic entry see Field 5F.
W87-05912

STABILIZATION OF DISPERSED MINERAL PARTICLES BY ADSORPTION OF HUMIC SUBSTANCES,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
M. R. Jekel.
Water Research WATRAG, Vol. 20, No. 12, p 1543-1554, December 1986. 14 fig, 2 tab, 38 ref. West German Federal Ministry of Research and Technology Grant 02- WT 002.

Descriptors: *Humic acids, *Adsorption, *Flocculation, *Dissolved solids, Silica, Kaolinite, Estuaries, Ozonation, Mathematical analysis.

The coagulation of suspended silica and kaolinite particles by electrolytes was studied by a photometric technique in the presence of three different humic extracts derived from the Ruhr River, and from the groundwaters of Hannover-Fuhrberg and Lake Hohloh in West Germany. The organic substances stabilize the dispersions with increasing dosages due to the adsorption of fractions of the dissolved organic carbon. Adsorption isotherms reveal the favorable uptake of high-molecular-weight substances and the role of pH and electrolyte content. Stabilization is primarily caused by adsorbed neutral molecules. The adsorption model developed describes the isotherm data based on three different fractions and can be used to predict the stabilization effects, if precipitation of calcium humate can be excluded. Colloid stability is thus determined by the free surface of particles and can be understood in relation to the action of synthetic polymeric stabilizers. Study of the physicochemical role of humic acids in the stabilization of colloids will help identify the processes involved in the microflocculation effect of low dose ozonation, an effect poorly understood at present. (Airone-PTT)
W87-05913

FORMATION EQUATION OF HALOGENATED ORGANIC COMPOUNDS WHEN WATER IS CHLORINATED,
Yokohama National Univ. (Japan). Dept. of Safety and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W87-05914

2L. Estuaries

FUNDAMENTAL RESEARCH ON ESTUARIES: THE IMPORTANCE OF AN INTERDISCIPLINARY APPROACH.
National Research Council, Washington, DC. Commission on Physical Sciences Mathematics and Resources.
Studies on Geophysics. National Academy Press, Washington, DC. 1983. NSF Grant No. EAR-79-02358, and NOAA Contract No. NA80AAA04492. 79 p.

Descriptors: *Estuaries, *Estuary environment, *Interdisciplinary studies, *Geology, *Biota, *Chemical properties, Chemical composition.

The basic need for research to understand the estuarine processes relating estuarine circulation, biota, geology, and chemistry is examined. it is reccommended that the primary focus of future research in estuaries should be on interdisciplinary relations, and such research should receive increased support to provide basic framework for informed management of estuarine systems. Included is a review of the uses of estuaries and the complexities therein, the environmental effects of estuarine biota, the variability of circulation and mixing, and the fate and effect of suspended and dissolved matter. (Ram-PTT)
W87-05253

EUTROPHICATION AND THE RATE OF DENITRIFICATION AND N2O PRODUCTION IN COASTAL MARINE SEDIMENTS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
S. P. Seitzinger, and S. W. Nixon.
Limnology and Oceanography LIOCAH, Vol. 30, No. 6, p 1332-1339, November 1986. 1 fig, 1 tab, 29 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Eutrophication, *Denitrification, *Marine sediments, *Rhode Island, *Narrangansett Bay, *Nitrogen compounds, *Coastal waters, *Nutrients, *Nitrogen removal, Inorganic compounds, Cores, Fluctuations, Nitrates, Wastewater disposal, Near-

shore processes, Benthic environments, Load Distribution.

Large (13 cu m, 5 m deep) microcosms with coupled pelagic and benthic components were used to measure the effect of nutrient loading and eutrophication in coastal marine ecosystems of Narragansett Bay, R.I. on the rates of benthic denitrification (N2) and N2O production. After 3 months of daily nutrient addidition, average denitrification rates ranged from about 300 micromol N/sq m/h in the sediments of the control microcosm to 880 in the most enriched microcosm, which received 65 times the nutrient input of the control. Increases in the production of N20 were more dramatic and increased by a factor of about 100, from 0.56 micromol N/sq m/h in the control to 51 in the most enriched microcosm. Although there was a clear increase in the denitrification rate in the more eutrophic systems, the amount of fixed nitrogen removed was a constant or progressively smaller fraction of the nitrogen input. Even in the most enriched microcosm, at least 16% of the N input was removed by denitrification. (Author's abstract)
W87-05306

CALCULATION OF WAVE-INDUCED TURBULENT FLOWS IN ESTUARIES,
I. Celik, and W. Rodi.
Ocean Engineering OCENBQ, Vol. 12, No. 6, p 531-542, 1985. 6 fig, 1 tab, 15 ref.

Descriptors: *Turbulent flow, *Waves, *Estuaries, *Mathematical analysis, *Model studies, *Humber Estuary, Eddies, Kinetic energy, Eddy diffusion, Mathematical models, Germany, Wave propagation.

The kappa-epsilon turbulence model which relates the eddy viscosity to turbulent kinetic energy, kappa, and to the rate of its dissipation, epsilon, and determines the distribution of these two quantities from modeled transport equations, was employed in calculating the vertical structure of wave-induced turbulent flows in two-dimensional estuaries. The empirical constants in this model are given the standard values cited in the literature and used successfully for calculating a large variety of steady flows; they are not tuned to the oscillating flows. The free surface elevation and the eddy-viscosity distribution were also calculated as a part of the solution. First, calculations performed for oscillatory laminar flows were compared with analytic solutions to ensure the proper performance of the numerical scheme. The turbulent flow in a laboratory-estuary model with one end closed, and in the Humber Estuary, is simulated with the numerical model, and the results were compared with the corresponding flume and field measurements. The influence of frequency and roughness may be thereby investigated. The results indicate that the time and space variation of the velocity field and the phase lag between the surface slope and the horizontal velocity can be predicted satisfactorily in wave-induced turbulent flows. (Author's abstract)
W87-05319

COMPARISON OF SHALLOW WATER MODEL RESULTS FOR THREE ESTIMATES OF A COMPOSITE EL NINO FORCING,
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. C. Weare.
Journal of the Atmospheric Sciences JAHSAK, Vol. 43, No. 2, p 162-170, January 15, 1986. 9 fig, 1 tab, 19 ref, append.

Descriptors: *Shallow water, *El Nino, *Storms, *Model studies, Water temperature, Convection, Wind, Weather patterns, Mathematical analysis, Atmospheric water, Heat flow.

A linear shallow water model on an equatorial beta-plane is driven by three different estimates of the heating rate perturbation during seven seasons of a composite El Nino episode. In two cases, the heating perturbations for this model were assumed to be closely linked to the pattern of sea surface temperature anomalies. In the third, the heating was related to direct estimates of precipitation departures. The model-derived winds based upon these three estimates were compared to one another and to data available from marine weather reports. An analysis of area averaged winds, surface latent heat fluxes and moisture convergences shows general agreement with observations over the composite El Nino seasons for the results of all three forcing estimates, although the model results using the direct precipitation estimates seem generally to be the poorest. A second analysis explores the similarity of smaller-scale features of the model results to the observations. This suggests that the simple parameterized heating using sea surface temperature estimates gives the only solutions which fairly well identify smaller-scale variations. (Author's abstract)
W87-05321

CADMIUM- AND MERCURY-RESISTANT BACILLUS STRAINS FROM A SALT MARSH AND FROM BOSTON HARBOR,
Brandeis Univ., Waltham, MA. Rosenstiel Basic Medical Sciences Research Center.
For primary bibliographic entry see Field 5C.
W87-05395

EFFECT OF TEMPERATURE ON GROWTH, RESPIRATION, AND NUTRIENT REGENERATION BY AN OMNIVOROUS MICROFLAGELLATE,
Woods Hole Oceanographic Institution, MA.
D. A. Caron, J. C. Goldman, and M. R. Dennett.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1340-1347, December 1986. 2 fig, 5 tab, 47 ref. NSF Grants OCE-858578 and OCE-8511283.

Descriptors: *Temperature effects, *Microflagellates, *Cycling nutrients, *Nutrients, *Growth rate, *Respiration, *Nitrogen, Diatoms, Protozoa, Cultures, Phytoplankton, Mineralization, Zooplankton.

It is now widely recognized that protozoa play a vital role in regulating energy flow and nutrient cycling in marine plankton communities. Indeed, we now have evidence that some microflagellates are omnivorous and thus may be important consumers of small phytoplankton as well as bacteria. Clearly, a firmer understanding of the trophic relationships of aquatic protozoa is beginning to emerge. However, we still know very little about how physical variables such as temperature influence growth and survival of these protozoan populations. The effect of temperature on the rates and extent of carbon and nitrogen cycling by the heterotrophic microflagellate Paraphysomonas imperforata (diameter, 7 to 12 micron) fed with the diatom Phaeodactylum tricornutum was investigated over an ecologically pertinent temperature range (14 to 26 C). All physiological rates investigated increased with increasing temperature. Q sub 10 values were similar for all rate changes and were comparable to those which have been reported for other protozoa. In contrast to all rates, microflagellate gross growth efficiency and cell volume were unaffected by temperature. Decreases in the concentrations of particulate carbon and particulate nitrogen from grazed diatom cultures also were similar when summed over the entire growth phase of the microflagellate population. Therefore, the proportions of ingested carbon and nitrogen which were incorporated or remineralized by the microglagellate were independent of temperature between 14 and 26 C. At temperatures above 18 C, growth rates of P. imperforata were greater than the maximum growth rates reported for most phytoplankton. We conclude that the impact of P. imperforata on natural phytoplankton communities is not controlled by temperature above 18 C but may be affected by the rate at which zooplankton or microzooplankton prey on the microflagellate, as well as the inability of the microflagellate to graze efficiently when phytoplankton are present at low cell densities. (Alexander-PTT)
W87-05399

OCCURRENCE AND DISTRIBUTION OF HALOPHILIC VIBRIOS IN SUBTROPICAL COASTAL WATERS OF HONG KONG,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W87-05402

FLUORESCENCE INDUCTION AND PHOTOSYNTHETIC RESPONSES OF ARCTIC ICE ALGAE TO SAMPLE TREATMENT AND SALINITY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 2H.
W87-05477

RELEASE OF REDUCING SUGARS AND DISSOLVED ORGANIC CARBON FROM SPARTINA ALTERNIFLORA LOISEL IN A GEORGIA SALT MARSH,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W87-05484

EVAPORATION-DRIVEN SALINITY MAXIMUM ZONE IN AUSTRALIAN TROPICAL ESTUARIES,
Australian Inst. of Marine Sciences, Townsville.
E. Wolanski.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 415-424, April 1986. 5 fig, 16 ref.

Descriptors: *Evaporation, *Salinity maximum zone, *Estuaries, *Tidal currents, *Australia, *Salinity, Downstream, Upstream, Downwelling, Mixing, Temperature.

In a typical partially well-mixed estuary the tide-averaged internal circulation comprises an upstream-directed flow of saline water near the bottom and a downstream-directed flow of less saline water near the surface. The salinity increases continuously from zero in the freshwater part of the estuary, to that of the receiving coastal waters. It has been recognized that, in some cases, evaporation can exceed runoff from precipitation. The definition of 'inverse estuary' is where the internal circulation is inverse to that in a classical estuary. Tropical estuaries in Australia in which evaporation is presumably important, have received very little attention from physical oceanographers. The distribution of temperature and salinity in three tropical Australian estuaries was measured in October 1983 in the hot dry season. As a result of evaporation, a salinity maximum zone exists near the mouth of the river, where downwelling occurs, and classical and an inverse internal estuarine circulation prevail, respectively, upstream and downstream of the salinity maximum zone. The zone of salinity maximum can be thought of as a high salinity plug inhibiting so much the mixing of estuarine and ocean waters that in some cases freshwater does not reach the ocean. (Alexander-PTT)
W87-05485

OBSERVED AND COMPUTED LATERAL CIRCULATION PATTERNS IN A PARTLY MIXED ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles, R. C. A. Elliott, and S. A. Weston.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 439-457, April 1986. 7 fig, 2 tab, 26 ref.

Descriptors: *Tidal currents, *Circulation patterns, *Estuaries, *Mathematical models, *Model studies, *Tides, Transport, Drift, Tamar Estuary, Intertidal areas, Runoff, Density gradient, Prediction, England.

Observations of lateral residual circulation patterns are presented for three sections in the upper reaches of the Tamar Estuary. The data include measurements over spring and neap tidal cycles, and are compared with predictions from a depth-averaged, numerical model of the lateral circulation. The model shows features of the lateral structure which also occur in the observed data. The

computed mass-transport Stokes drift has a similar lateral structure at spring and neap tides for all sections, and is up-estuary in the deeper, central part of a section, and down-estuary on the intertidal areas near the banks. A distinctive feature of this drift is the reduction in lateral structure when axial density gradients are ignored. The mass-transport residual current has a characteristic lateral structure when the run-off is not too high. The current in the central part of a section is slow (less than a few cm/s), and may be up- or down-estuary, depending on the magnitude of the run-off. The current over the intertidal areas is faster (10 cm/s) and directed down-estuary. This distribution consists of three components: (a) a run-off induced current which has a river-like form, (b) density currents which are up-estuary in the deeper part of a section and down-estuary over the intertidal and shallow areas, and (c) tidally-driven currents which have a similar form to density currents, and whose formation depends strongly on the existence of intertidal areas. Results from this paper are compared with published observations of lateral circulation patterns for several other estuaries. (Author's abstract)
W87-05487

GEOCHEMISTRY OF TRACE METALS IN THE BRAZOS RIVER ESTUARY,
Texas A and M Univ., College Station. Dept. of Chemistry.
W. L. Keeney-Kennicutt, and B. J. Presley.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 459-477, April 1986. 11 fig, 2 tab, 48 ref. NSF Grant OCE76-23829.

Descriptors: *Trace metals, *Trace elements, *Brazos River estuary, *Estuaries, Mixing zone, Transport, Gulf of Mexico, Surface water, Sediments, Water analysis, Ions, Nutrients, Humic acids, Alkalinity, Seasonal variation, Seawater.

Considerable effort has been expended over the last decade to more fully understand the physicochemical behavior of inorganic constituents, particularly trace metals, across the river water-seawater mixing zone. These studies have often resulted in conflicting conclusions. A seasonal study of trace metal behavior and transport in the Brazos River estuary was conducted in the winter, spring and fall of 1981. Surface water was analyzed for total dissolved Pb, Cu, Mn and Fe, and particulate Cd, Pb, Cu, Mn and Fe. Ancillary data included river discharge, total suspended matter, pH, major ions, nutrients, dissolved and particulate organic carbon and humic acid. The major ions were generally conservative across the river water-seawater mixing zone; however, a significant input of alkalinity and Ca was measured in the spring, attributable to cation exchange on clays and sediment diagenetic processes. Distinct concentration maxima were found in the .3-1.0% chlorinity range for dissolved Pb (0.06-0.9 nM), Cu (6-42 nM), Mn (2-290 nM) and Fe (5-80 nM). Particulate metal concentrations showed significant seasonal and spatial variations: Cd, 0.09-0.57 ppm; Pb, 15-43 ppm; Cu, 12-32 ppm; Mn, 250-1990 ppm and Fe 0.5-5.4%. Reducing conditions leading to diagenetic remobilization in estuarine sediments are proposed to be an important source of dissolved metals for estuarine water. Calculations of dissolved riverine metal transport to the ocean that include estuarine metal input are as much as 40 times greater than when estuarine processes are ignored. (Alexander-PTT)
W87-05488

ELECTROCHEMICAL STUDY OF THE SPECIATION OF COPPER, ZINC AND IRON IN TWO ESTUARIES IN ENGLAND,
Liverpool Univ. (England). Dept. of Oceanography.
C. M. G. van den Berg, P. J. M. Buckley, Z. Q. Huang, and M. Nimmo.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 479-486, April 1986. 3 fig, 29 ref.

Descriptors: *Electrochemistry, *Estuaries, *Speciation, *Cathodic stripping voltammetry, *Copper, *Zinc, *Iron, *Water analysis, Colloids, Acidification, Sample preparation, Tamar estuary, Heavy metals, Vanadium, Salinity, River Ribble, England.

The study of metal speciation depends on the availability of techniques that specifically measure certain well-defined fractions of the total metal concentration. The free fraction for instance can be measured separately by direct sensing with an ion-selective electrode or kinetically by anodic stripping voltammetry (ASV). The organic speciation of copper, iron and zinc in estuarine waters is studied using electrochemical techniques. Complexing capacities for copper and zinc were determined by cathodic stripping voltammetry (CSV) of their complexes with respectively catechol and amino pyrrolidine dithiocarbamate (APDC). Iron speciation was studies by CSV measurements of dissolved iron before ('free iron') and after acidification and UV-irradiation ('total iron') of the filtered samples. Complexing capacities of copper were found to vary between .00000014 and .0000005 M with conditional stability constants between 9.2 and 10.3 in the Tamar estuary. Complexing capacities of zinc were less at between .00000004 and .00000016 M with values for stability constant between 8.1 and 9.4. Copper complexing capacities generally decreased with increasing salinity, and variations in the results were related to high concentrations suggested that part of this element was associated with colloidal material. The total dissolved iron concentration in samples from the River Ribble decreased from .000001 M at low salinity to .0000001 M at high salinity, but the free iron concentration was found to decrease from 8 to 3 x ten to the minus 8th power M over the same salinity range, which may be compared with the calculated solubility of iron in seawater of 2 x ten to the minus 8th power M. Comparative experiments showed that on average about 24% of the non-labile iron fraction was stabilized by organic material, the rest being composed of inorganic colloidal material. (Alexander-PTT)
W87-05489

MORPHOLOGICAL CHANGES OF THE ARTIFICIAL INLETS OF THE BARDAWIL LAGOON,
Haifa Univ. (Israel). Dept. of Geography.
M. Klein.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 487-493, April 1986. 2 fig, 2 tab, 5 ref.

Descriptors: *Artificial inlets, *Bardawil lagoon, *Lagoons, *Sediment budget, *Dredging, Shorelines, Topography, Morphology, Inlets, Mediterranean Sea, Aswan High Dam, Aerial photography.

The Bardawil lagoon is situated in the north of the Sinai Peninsula. The total area of the water surface is about 600 sq Km, and the average water depth in the lagoon is 1.5-2 m. The lagoon is separated from the Mediterranean Sea by an 80 km long sand barrier. In natural conditions, without the opening of artificial inlets, the water salinity of the lagoon may exceed 10%, and the lagoon may dry out becoming a dry salt pan. The lagoon is situated in a microtidal area, in which the longshore sediment transport is dominant for morphological changes. The topographic changes in the shoreline around the artificial inlets of the Bardawil lagoon were studied using aerial photographs. The amount of sediment dredged during the years 1970-1977 is about 50% of the amount predicted in 1970. It is suggested that the difference between the two is the result of the 'new' sediment budget of the South-East Mediterranean due to the effect of Aswan High Dam. (Alexander-PTT)
W87-05490

QUANTITATIVE REPRODUCTION AND REPRODUCTIVE EFFORT BY STANDS OF THE BROWN ALGA ASCOPHYLLUM NODOSUM (L.) LE JOLIS IN SOUTH-EASTERN CANADA,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
R. Cousens.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 495-507, April 1986. 7 fig, 1 tab, 23 ref.

Descriptors: *Brown algae, *Reproduction, *Coastal waters, *Nova Scotia, *Biomass, *Algal growth, *Annual productivity, Productivity, Canada, Algae, Standing crops, Growth, Competition, Waves, Canopy.

Quantitative variation in reproduction has been studied a great deal in higher plants. A number of generalizations have been made concerning the relationships between the investment in reproduction and environmental variables. Quantitative variation in reproduction by the perennial brown algae Ascophyllum nodosum (L.) Le Jolis was examined around the coast of Nova Scotia. Annual reproductive effort is defined as the proportion of net annual production which is invested in reproduction. This is distinct from the reproductive proportion of biomass, which is the annual reproduction as a proportion of the total standing crop including vegetative growth from previous years. Variation in reproduction around the coast was considerable, but did not appear to follow any directional trends. With increasing shelter from wave action the reproductive standing crop showed a marked increase, whereas annual reproductive effort decreased. No clear trend in reproductive effort was found with shore level. Overall, there was a decrease in reproductive effort with increasing standing crop and the raising of the algal canopy. This is discussed in relation to the intensity of competition. (Alexander-PTT)
W87-05491

FISH SPECIES COMPOSITION IN NEW JERSEY SALT MARSHES: EFFECTS OF MARSH ALTERATIONS FOR MOSQUITO CONTROL,
Rutgers - The State Univ., New Brunswick, NJ. Zoology Graduate Program.
C. W. Talbot, K. W. Able, and J. K. Shisler.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 2, p 269-278, March 1986. 4 fig, 3 tab, 31 ref. NJ State Mosquito Commission Grant NJAES 40503.

Descriptors: *Species composition, *Salt marshes, *Marsh management, *Mosquito control, *New Jersey, *Fish populations, Tidal currents, Seasonal variation, Salinity, Habitats, Marshes, Fish.

Fish species composition and richness were compared among an unaltered New Jersey salt marsh and marshes altered for mosquito control, based on monthly seine collections over a year. Impounded marshes (stop-ditched and low-level impoundments) had distinctly different fish assemblages from that of an unaltered marsh. Marshes altered by open marsh water management (OMWM) techniques had tidal flows and assemblages similar to that of an unaltered marsh. The most pronounced dissimilarities in species composition were attributable to differences in salinity. Freshwater and oligohaline species dominated in low salinities, such as in some impounded areas. In the higher-salinity areas, as in OMWM and unaltered marshes, a typical estuarine assemblage was abundant. Movements of some species from OMWM and unaltered sites in winter caused characteristic changes in faunal composition and abundance. Among impoundments, however, seasonal patterns of species composition, richness, and abundance varied inconsistently. regardless of type of alteration, salinity and habitat preference appeared to account for most of the variation in species composition and richness. (Author's abstract)
W87-05497

IN VITRO METABOLISM AND IN VIVO BINDING OF BENZO(A)PYRENE IN THE CALIFORNIA KILLIFISH (FUNDULUS PARVIPINNIS) AND SPECKLED SANDDAB (CITHARICTHYS STIGMAEOUS),
University of Southern California, Los Angeles. Dept. of Pathology.
For primary bibliographic entry see Field 5C.
W87-05500

CONCENTRATED BRINES AS HABITATS FOR MICROORGANISMS,
Bonn Univ. (Germany, F.R.). Inst. fuer Mikrobiologie.
For primary bibliographic entry see Field 2H.

W87-05552

MATHEMATICAL MODEL STUDY OF TIDAL CIRCULATION IN TOLO HARBOUR, HONG KONG: DEVELOPMENT AND VERIFICATION OF A SEMI-IMPLICIT FINITE ELEMENT SCHEME,

Hong Kong Univ. Dept. of Civil Engineering.
C. W. Li, J. H. W. Lee, and Y. K. Cheung.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 81, Part 2, p 569-592, December 1986. 13 fig, 20 ref.

Descriptors: *Hydraulic models, *Hong Kong, *Harbors, *Fourier analysis, *Tidal basins, *Model studies, *Hydrodynamics, *Tidal currents, *Mathematical models, Standing waves, Bays, Calibration, Simulation.

The tidal circulation in Tolo Harbor, Hong Kong, was computed by a newly developed semi-implicit finite element model. The accuracy and efficiency of the unconditionally stable time-stepping scheme are confirmed by a detailed Fourier analysis and extensive tests against analytical solutions of long wave propagation in basins of varying lateral topography and bottom bathymetry. With M2 tidal forcing at the seaward (open) boundary, the model is capable of reproducing the near standing wave and characteristic circulation in the bay. Computed velocities and elevations are also validated against good quality field data in a verification study. It is found that accurate input tides at the seaward boundary of the model are needed to simulate the propagation of the complex shallow water tides in a study area. The correctly simulated tidal phase lag between the open boundary and inshore is found to be at variance with data in published tide tables. (Author's abstract)
W87-05568

PHOTOMETRIC DETERMINATION OF TIN, ZIRCONIUM, NIOBIUM, AND TANTALUM IN SEA ALGAE,

Fiziko-Khimicheskii Inst., Odessa (USSR).
For primary bibliographic entry see Field 5A.
W87-05585

CLUSTER ANALYSIS APPROACH TO STUDY HEAVY METALS DISTRIBUTION IN MARINE ORGANISMS,

Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W87-05586

FACTORS AFFECTING SHORT-TERM VARIABILITY IN SEDIMENT PH AS A FUNCTION OF MARSH ELEVATION IN A VIRGINIA MESOHALINE MARSH,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
T. G. Wolaver, J. Zieman, and B. Kjerfve.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 101, No. 3, p 227-237, November 1986. 4 fig, 2 tab, 13 ref.

Descriptors: *Marine sediments, *Hydrogen ion concentration, *Elevation, *Salt marshes, Salinity, Virginia, Transpiration, Macrophytes, Tidal effects.

An analysis of 5 days of nearly continuously recorded sediment temperature, pH, and radiation measurements along a transect in the fringe marsh of Carter Creek, Virginia, suggests that there was a shift in control over short-term pH variability from tidal inundation to radiation with height of marsh surface at least in the surficial sediments. There was little evidence for tidal control of pH variability at depth in the sediment column. However, biological control of subsurface pH variability was evident both near the tidal creek and in the high marsh. The latter zone had the highest pH variability, with diurnal pH excursions up to two units being observed. It is hypothesized that macrophyte transpiration or a series of interlocking mechanisms associated with photosynthesis and microbial activity were responsible for the pH excursions observed at depth in the marsh, since the rapid changes in pH were triggered at sunrise and sunset. The large excursions in sediment pH in the high marsh rhizosphere suggest that geochemical activity may be dynamic over the diurnal cycle. (Author's abstract)
W87-05589

OCCURRENCE AND ECOLOGICAL SIGNIFICANCE OF VESICULAR ARBUSCULAR MYCORRHIZA IN THE SALT MARSH ENVIRONMENT,

Vrije Univ., Amsterdam (Netherlands). Dept. of Ecology and Ecotoxicology.
J. Rozema, W. Arp, J. Van Diggelen, M. Van Esbroek, and R. Broekman.
Acta Botanica Neerlandica ABNRAN, Vol. 35, No. 4, p 457-467, November 1986. 3 fig, 1 tab, 41 ref.

Descriptors: *Mycorrhiza, *Plant pathology, *Fungi, *Plant diseases, *Salt marshes, *Marshes, *Salinity, Salts, Diseases, Plant growth, Infection, Sodium, Sodium chloride, Phosphorus, Potassium, Leaves, Roots, Water transport, Stomata, Photosynthesis.

The infection by vesicular arbuscular mycorrhizal fungi (VAM) of various salt marsh plant species has been estimated and compared. This kind of infection appeared to be high or intermediate and frequent in Aster tripolium, Plantago maritima, Glaux maritima and Festuca rubra ssp. litoralis, rare or absent in Spartina angelica, Triglochin maritima, Juncus gerardii, J. maritimus, Atriplex hastata and Suaeda maritima and variable or intermediate in Salicornia dolichostachya and S. brachystachya. The sodium content of shoots of mycorrhizal Aster tripolium plants was lower than of non-mycorrhizal plants when grown at 300 mM NaCl. The potassium and phosphorus content of the shoot was not significantly affected by the presence of mycorrhiza. Improved growth of mycorrhizal plants of Aster tripolium under salinity stress could be related to increased water uptake by mycorrhizal roots. The causes of increased water uptake in mycorrhizal plants are discussed in terms of reduced root resistance to water transport and its consequences for prolonged stomatal opening and increased photosynthesis. (Author's abstract)
W87-05613

ADAPTATION OF ESTUARINE ECOSYSTEMS TO THE BIODEGRADATION OF NITRILOTRIACETIC ACID: EFFECTS OF PREEXPOSURE,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5C.
W87-05617

TRACE METALS IN MUSSELS TRANSPLANTED TO SAN FRANCISCO BAY,

Moss Landing Marine Labs., CA.
For primary bibliographic entry see Field 5B.
W87-05650

SOILS AND SOLUTE PATTERNS IN RECLAIMED ESTUARINE MARSHLAND IN SOUTH-EAST ENGLAND,

Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 2G.
W87-05701

SEDIMENT IN MUGU LAGOON, VENTURA COUNTY, CALIFORNIA,

Soil Conservation Service, Davis, CO.
For primary bibliographic entry see Field 2J.
W87-05773

BIOGENIC EFFECTS ON DEVELOPMENT OF MAGNETIC FABRICS IN COASTAL GEORGIA SEDIMENTS,

Georgia Univ., Athens. Dept. of Geology.
R. M. Chernow, R. W. Frey, and B. B. Ellwood.
Journal of Sedimentary Petrology JSEPAK, Vol. 56, No. 1, p 160-172, January 1986. 8 fig, 5 tab, 53 ref.

Descriptors: *Sediments, *Coastal marshes, *Magnetic studies, *Magnetic fabrics, *Bioturbated sediments, Intertidal sediments, Anisotropy, Magnetic susceptibility, Deposition, Benthos, Magnetite, Sapelo Island, Georgia.

Anisotropy of magnetic susceptibility (ASM) measurements, used to characterize the fabric of magnetic grains in sediments, have provided useful information concerning primary and secondary depositional processes. Primary fabrics may be disrupted by a variety of physical, chemical, and biological processes. This study examined the possible influences that burrowing organisms exert upon the development and disruption of sedimentary fabrics in selected intertidal substrates by measuring the AMS in sediments containing artificially emplaced magnetite grains. Some bioturbated sediments exhibited primary fabric characteristics, typified by horizontal long- and intermediate-axial inclinations, near-vertical short-axis inclinations, and AMS parameters $V > 45$ degrees and $Q < 0.69$. A primary magnetic foliation suggests that secondary physical, rather than biological, processes were responsible for the observed fabric. Evidently, the activities of burrowing organisms initially expanded the sediments, permitting subsequent grain settling and readjustment. Both gravitational and hydrodynamic forces may reorient such grains, creating an improved but secondary magnetic fabric. These primary characteristics indicate that bioturbation per se does not necessarily result in a permanent, random, secondary fabric. Furthermore, some open burrows serve as sediment traps: repeated burrow excavation and passive filling results in a mosaic of individual, nonrandom depositional fabrics within the substrate. (Authors' abstract)
W87-05859

SPATIAL AND TEMPORAL CHANGES IN LOUISIANA'S BARATARIA BASIN MARSHES, 1945-1980,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. E. Sasser, M. D. Dozier, J. G. Gosselink, and J. M. Hill.
Environmental Management EMNGDC, Vol. 10, No. 5, p 671-680, September 1986. 6 fig, 2 tab, 21 ref.

Descriptors: *Wetlands, *Coastal marshes, *Coastal zone management, *Canals, *Wetlands, *Saline water intrusion, Remote sensing, Subsidence, Environmental effects, Louisiana.

Wetland degradation and loss to open water are problems of serious concern in southern Louisiana, a region that has 40% of all remaining coastal wetlands in the 48 contiguous states. A computerized geographic information system with site-specific change-detection capabilities was developed to document amounts, rates, locations, and sequences of loss of coastal marsh to open water in Barataria Basin, Louisiana. Land-water interpretations based on 1945, 1956, 1969, and 1980 aerial photographs were used as input, and a modified version of the Earth Resources Laboratory Applications Software developed by the National Aeronautics and Space Administration was used as a spatial data base management system. Analysis of these data sets indicates that rates of marsh loss have increased from 0.36% per year in the 1945-56 period, to 1.03% per year in 1956-69, and to 1.96% per year in 1969-80. The patterns of marsh loss indicate that the combination of processes causing degradation of the marsh surface does not affect all areas uniformly. Marsh loss rates have been highest where freshwater marshes have been subject to saltwater intrusion. The increase in the wetland loss rates corresponds to accelerated rates of subsidence and canal dredging and to a cumulative increase in the area of canals and spoil deposits. (Authors' abstract)
W87-05876

EFFECTS OF SEDIMENTATION ON REMOVAL OF FAECAL COLIFORM BACTERIA FROM EFFLUENTS IN ESTUARINE WATER,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 2J.
W87-05906

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING BY REVERSE OSMOSIS AT YUMA DESALTING PLANT,
Bureau of Reclamation, Yuma, AZ. Yuma Projects Office.
K. M. Trompeter, and S. H. Suemoto.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 427-437, 5 fig.

Descriptors: *Desalination plants, *Yuma, *Arizona, *Reverse osmosis, Desalination, Sedimentation, Lime softening, Filtration, Scaling, Construction.

The pretreatment and desalting systems at Yuma Desalting Plant, Yuma, Arizona include sedimentation, partial lime softening, filtration, scale inhibitors, and the reverse osmosis desalting. Other plant features are office, maintenance areas, computer control, energy recovery, and improving performance of treatment by use of Test Train. The completed works include intake, sedimentation basin, bypass drain, and switchyard. Construction is in progress on Solid Contact Reactors, Dual-Media filter and clearwells, chemical storage and handling areas as well as the Test Train. Yet to be constructed are Desalting Plant Building, railway siding, disposal pipeline, and disposal site, and the installation of process pumps and turbines, computer control system, and desalting equipment. (See also W87-05165) (Lantz-PTT)
W87-05205

POTENTIAL FOR UTILIZATION OF BRACKISH GROUNDWATER,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 3C.
W87-05227

3B. Water Yield Improvement

ENHANCED RECOVERY OF GROUNDWATER FROM THE UNSATURATED ZONE: THE OGALLALA CASE,
Texas Agricultural Experiment Station, College Station.
For primary bibliographic entry see Field 4B.
W87-05223

RESEARCH CONTRIBUTIONS TO WATER CONSERVATION TECHNOLOGIES,
Texas Agricultural Experiment Station, Lubbock.
W. M. Lyle, and E. A. Hiler.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 297-308, 27 ref.

Descriptors: *Water conservation, *Research priorities, *Agriculture, *Irrigation practices, Supplemental irrigation, Deficity irrigation, Yield, Cost-benefit analysis, Cropping, Irrigation, Groundwater, Surface water.

Agriculture accounts for 70 to 75% of the water used in Texas. Eighty-two percent of this is from groundwater, a nonrenewable resource in the High Plains which is being mined. The declining water supplies in Texas have made it imperative for research to concentrate on maximizing the efficiency of the total water resource, which includes rainfall, and to concentrate much of the irrigation research on supplemental or deficit irrigation. The term supplemental irrigation is used primarily where a continental type climate produces significant rainfall during the spring through fall growing season. In this case, irrigation truly supplements the variable growing season rainfall which plays an important role in water management decisions. The term deficit irrigation may also be applicable because the applied water or applied water plus rainfall is inadequate to supply the amount of moisture necessary for maximum crop yield. In many areas, rising energy costs and declining water supplies are changing management strategies and attitudes to that of maximizing yields on the basis of per unit water applied rather than per unit area. Where water is very limited relative to land area, the economic objective should be to maximize net profit over the total available land area. Numerous areas in which research has contributed to this (cropping, land forming, irrigation scheduling, and irrigation application systems and strategies) are discussed. (See also W87-05219) (Lantz-PTT)
W87-05239

3C. Use Of Water Of Impaired Quality

IRRIGATION WITH SALINE GROUNDWATER AS A STRATEGY FOR SALINITY CONTROL IN THE SHEPPARTON REGION OF NORTHERN VICTORIA.
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 255-264, 2 tab, 15 ref.

Descriptors: *Irrigation practices, *Saline water, *Salinity, *Water quality control, *Victoria, *Australia, *Groundwater irrigation, *Impaired water use, Groundwater quality, Cost analysis, Victoria.

There is scope to use considerable volumes of moderately saline groundwater for irrigation in the Shepparton Region of Northern Victoria. Perennial pastures can be irrigated safely with water of salinity up to 1.0 dS/m and water of higher salinity can be used on other more tolerant crops, such as lucerne. Where necessary the addition of low levels of calcium (1-3 mo./cu m) to the groundwater can prevent dispersion and maintain the exchangeable sodium percentage of the soil at an acceptable level. This ability to use the groundwater for irrigation allows a strategy for salinity and water table control to be adopted which is based primarily on the on-farm pumping and re-use of groundwater. Such an on-farm strategy has a number of benefits over previous proposals including those which re-use substantial amounts of groundwater (up to 50%) though dilution in the water supply system. These include: matching irrigation water salinity to suit particular crops, soils and management methods; maximizing the productive use of groundwater and thereby minimizing the amount of salt outfallen to the Murray River; farmer owned and operated pumps cost less than State owned pumps; on-farm methods potentially apply to the whole area of the irrigated lands; and greater flexibility of irrigation management including the opportunity to irrigate during winter. The main uncertainty associated with the on-farm approach is whether aquifer salinity may deteriorate because of intrusion of water from more saline aquifers. (See also W87-05165) (Lantz-PTT)
W87-05188

REUSING SALINE DRAINAGE WATERS FOR IRRIGATION: A STRATEGY TO REDUCE SALT LOADING OF RIVERS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
J. D. Rhoades.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 455-464, 10 ref.

Descriptors: *Water reuse, *Impaired water use, *Saline water, *Irrigation practices, Rivers, Water quality control, Saline soils, Crop yield.

A strategy to control the salinity of river systems is to intercept drainage returns before they are mixed back in the river, and to use them for irrigation by substituting them for the river water normally used for irrigation at certain periods during the irrigation season of certain crops in the rotation. When the drainage water quality is such that its potential for reuse is exhausted then this drainage is discharged to evaporation ponds. This strategy conserves water, sustains crop production, minimizes the salt loading of rivers, and reduces the amount of river water diverted for irrigation. Its primary objectives are to substitute drainage water for some of the river water used for irrigation without significant yield reduction, loss in cropping flexibility, or change in current farming operations. The strategy is to irrigate salt sensitive crops (lettuce, alfalfa, etc) in the rotation with river water and salt tolerant crops (cotton, sugar beets, wheat, etc) with drainage water. For the tolerant crops, the switch to drainage water would usually occur after seedling establishment. The feasibility of this strategy is supported by the following: (1) the maximum soil salinity in the rootzone resulting from continuous use of drainage water will not occur when such water is only used for a fraction of the time; (2) substantial alleviation of salt build-up resulting from irrigation of salt tolerant crops with drainage water will occur during the time salt-sensitive crops are irrigated with river water; (3) proper preplant irrigation and careful irrigation management during germination and seedling establishment leaches salts out of the seed area and from shallow soil depths; and (4) data obtained in field experiments to data support the credibility of this 'cyclic' reuse strategy. That this strategy is valid has yet to be established because the long-term consequences have not yet been fully evaluated. (See also W87-05165) (Lantz-PTT)
W87-05207

IRRIGATION AS A SOLUTION TO SALINITY PROBLEMS OF RIVER SYSTEMS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
G. R. Dutt, D. A. Pennington, and F. Turner.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 465-472, 8 tab, 8 ref.

Descriptors: *Water reuse, *Irrigation practices, *Saline water, *Colorado River, *Impaired water use, Salinity, Agriculture, Water quality control, Saline soils, Crop yield.

Since legislation in the United States requires that no further increase in salinity in river systems be allowed, methods of diverting the flow of highly saline water from river systems must be found. The strategy to deal with this problem on the Colorado River, as formulated by the Bureau of Reclamation, was to first identify several saline flows into the river. An alternative to desalinization would be the construction of saline irrigation projects close to the mouth of the tributaries with a river system. Using the Colorado river system as an example, the quality of the waters to be diverted is considered. It should be noted that over 95% of the waters to be diverted from the river have an electrical conductivity of less than 7.2 d/Sm. Arizona farmers have long recorded the use of well waters of this conductivity. Although farms using these highly saline waters are severely restricted in choice of crops, their farms none the less form valid economic units. Soils chosen to be irrigated with saline waters should be deep, highly permeable, and capable of being drained by either surface or well-drainage systems. To minimize water storage the area should be capable of producing corps over a 12-month period. In addition, these projects should be located so that the brine created by

drainage can be disposed of in either evaporation ponds or to a drain. Irrigation systems used should be of the precision type, that is, dead-level basin or furrows or possibly drip irrigation. If possible, a relatively good quality water should be available for germination. Germination should be accomplished by sprinkler, alternate furrow or drip methods. Special shaping of beds to avoid salt buildup is also helpful. (See also W87-05165) (Lantz-PTT)
W87-05208

USE OF SALINE WASTE WATER FROM ELECTRICAL POWER PLANTS FOR IRRIGATION,
Utah State Univ., Logan.
R. J. Hanks, R. F. Nielson, R. L. Cartee, and L. S. Willardson.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 473-482, 8 fig, 1 tab, 4 ref.

Descriptors: *Wastewater irrigation, *Powerplants, *Saline water, *Industrial wastewater, Huntington, Utah, Irrigation practices, Wastewater disposal, Saline soils, Salts.

Research on the use of saline water for irrigation has been conducted since 1977 at Huntington, Utah with cooling water from the Utah Power and Light Company Huntington plant. Water is partially 'consumed' as it is recycled in the evaporation-cooling system of the power plant until the salinity of the water reaches a high level at which time it is disposed of as 'waste'water. This wastewater is delivered to a holding pond from which it is pumped onto an adjacent farm for irrigation. The wastewater is used for irrigation to increase crop production as well as disposing of the wastewater. Controlled irrigation use has been found to be the best economic alternative for disposing crop production caused by use of water for power plant cooling rather than for irrigation. The process of evaporation during the cooling phase of power plant operation is analogous to the evapotranspiration process under crop production. Irrigation water, with a certain concentration of salts, is subject to evaporation and transpiration by crops. The water lost to the atmosphere is essentially pure water which leaves the salt in the remaining liquid solution in the soil. The salinity of the soil solution increases as the number of evaporation (E) or evapotranspiration (ET) cycles increases. In a river system, water is diverted for irrigation at many points along the way and return flow or drainage from irrigation is returned to the river. Thus the river water generally becomes more saline in a downstream direction. Five years of experience at Huntington, Utah shows a stability in production for forage and grain crops but a continuing production decrease on root crops. Work will continue and specific ion effects will be evaluated to determine their importance for long term management. (See also W87-05165) (Lantz-PTT)
W87-05209

SALT GRADIENT SOLAR PONDS.
Corps of Engineers, Tulsa, OK.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 493-502, 5 fig, 1 tab.

Descriptors: *Salt gradients, *Solar ponds, *Truscott Brine Lake, *Brines, *Wichita River, Water reuse, Arkansas River, Red River, Electric powerplants, Cost analysis, Economic aspects.

The Truscott Brine Lake is being constructed to impound highly brackish water from a number of sources which would normally flow into the Wichita River, a tributary of the Red River in Knox County, Texas. A 35.4-km (22-mile) pipeline is being constructed to carry the brines from their primary source to the Truscott Brine Lake site. The reservoir is designed to contain 100 years of brine emissions from three chloride emission areas in the Wichita River Basin. The solar ponds and power generating facilities would be located in the Bluff Creek arm of Truscott Brine Lake, which is approximately four miles due west of Truscott, Texas. As currently designed, the Truscott Brine Lake solar pond project is marginally uneconomical because of the limitations in size dictated by present extent of experience with large ponds, but there is good reason to believe that ultimately solar pond power plants can be economical in the Arkansas-Red River Basin. A study conducted by the Jet Propulsion Laboratory, concluded that solar ponds have the potential to supply 5.5 quads of thermal energy and 3.5 quads of electric energy nationally which combined represents about 7% of the projected energy demand in the year 2000. The Red River Basin has the potential to supply 1.4 quads of thermal energy and 2.0 quads of electric energy. Other benefits that tend to offset the only-marginal attractiveness of the project when considered strictly from a financial point of view include: advances, resolution of technical uncertainties, resolution of economic uncertainties, developing solar pond expertise for U.S. manufacturers and designers, and support demonstrated by local interests in solar ponds. (See also W87-05165) (Lantz-PTT)
W87-05211

POTENTIAL FOR UTILIZATION OF BRACKISH GROUNDWATER,
Texas Dept. of Water Resources, Austin.
J. D. Beffort.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 111-126, 3 fig, 3 tab, 5 ref.

Descriptors: *Impaired water use, *Brackish water, *Groundwater management, *Desalination, *Texas, Distillation, Electrodialysis, Reverse osmosis, Cost analysis, Groundwater quality, Saline water intrusion, Brine, Brine disposal.

Extensive development and use of groundwater in Texas has resulted in several types of problems, some local in nature, others more widespread. In West Texas, the rate of water use from the High Plains (Ogallala) Aquifer for agriculture and other purposes far exceeds the rate of natural recharge; and along parts of the Gulf Coast, large-scale pumpage of groundwater has resulted in land surface subsidence, saline water encroachment, and fault activation. Problems of water quality, both from natural and man-made causes, affect the suitability of water that is available from portions of most of Texas' aquifers. Moreover, groundwater, ulike surface water, is the property of the overlying landowner, and its use is subject to very few limitations. Of the 17.9 million acre-ft of water that Texans currently use annually, about 10.9 million is from groundwater sources. Solutions to the present local and projected statewide water supply deficits are not to be limited to any one method, but will require both conventional and innovative means. Additional groundwater and surface water development will be employed to the extent possible, while conservation, reuse, desalinization, and weather modification will assume roles of increasing importance. This paper deals with the potential in Texas for the desalinization of brackish groundwater to augment sources of supply in some areas of the state. Desalinization processes presented are: (1) distillation; (2) electrodialysis; and (3) reverse osmosis. Desalinization costs, brine disposal and potential deslinization development in Texas are discussed. (See also W87-05219) (Lantz-PTT)
W87-05227

DOWN TO THE VERY LAST DROP,
N. Meyers.
Nature NATUAS, Vol. 322, No. 6081, p 677, August 1986.

Descriptors: *Israel, *Water shortage, *Water conservation, *Wastewater irrigation, Cotton, Aquifers, Water pollution prevention.

Israel is now suffering the worst water shortage in its history despite having one of the most comprehensive water planning systems in the world. The past three years were not particularly dry, but the country has simply used more water than it can supply. What is needed is a policy to build up a national water reserve equal to three years' consumption. Cotton acreage is being reduced this year as an emergency conservation measure. Advocates of cotton maintain that it can be irrigated with sewage water, but this could be potentially dangerous because of the possibility of introducing pollutants into the aquifer. It is proposed that sewage irrigation be limited to areas such as the semi-arid Negev where there is practically no danger of polluting important aquifers. (Michael-PTT)
W87-05256

LEAF-SURFACE PROPERTIES IN RELATION TO TOLERANCE OF SALT SPRAY IN FESTUCA RUBRA SSP. LITORALIS (G. F. W. MEYER) AUQUIER,
Welsh Plant Breeding Station, Aberystwyth.
M. O. Humphreys, M. P. Kraus, and R. G. Wyn Jones.
New Phytologist NEPHAV, Vol. 103, No. 4, p 717-723, August 1986. 3 fig, 3 tab, 18 ref.

Descriptors: *Water pollution effects, *Leaves, *Salt tolerance, Plant tissues, Salt retention, Wettability, Adaptation, Plant physiology, Plant tissues, Plant morphology, Salt spray, Electron microscopy, Photosynthesis, Plant growth.

Leaf-surface properties were investigated in F. rubra ssp. litoralis (G. F. W. Meyer) Auquier cv. Hawk, which is tolerant of salt spray, and cv. Aberystwyth S. 59, which is susceptible. Salt retention and leaf wettabilities were measured and leaf-surface structure was observed using a scanning electron microscope. In both cultivars, stomata were confined to adaxial leaf surfaces which were less wettable than abaxial surfaces probably because of ridging and wax deposits. Salt retention after spraying was much higher per unit of dry weight in S. 59 than in Hawk, although salt retention per unit of projected leaf area was similar in both cultivars. This was because leaves were folded around the midrib in Hawk but were much flatter in S. 59. Folding reduced the exposure of adaxial leaf surfaces to salt spray. Differences in leaf folding and orientation can affect transpiration rates and photosynthesis, which, in turn, may affect growth rates. Hawk and other salt tolerant populations have intrinsically slower growth rates in non-saline conditions than S. 59. Differences in leaf morphology could be partly responsible for this, but a slow growth rate may also reflect other physiological adaptations to salt stress such as maintenance of high cell sugar levels. (Author's abstract)
W87-05267

TOLERANCE OF SODIUM CHLORIDE AND ITS GENETIC BASIS IN NATURAL POPULATIONS OF FOUR GRASS SPECIES,
Liverpool Univ. (England). Dept. of Botany.
M. Ashraf, T. McNeilly, and A. D. Bradshaw.
New Phytologist NEPHAV, Vol. 103, No. 4, p 725-734, August 1986. 1 fig, 3 tab, 18 ref.

Descriptors: *Water pollution effects, *Grasses, *Salt tolerance, Salt marshes, Salt spray, Sodium, Saline soils, Conductivity, Heritability.

Tolerance to sodium chloride in solution culture and its genetic basis was assessed for populations of four grass species from salt marsh, spray zone and inland habitats. Two populations of one species from salt marshes and one population of a species from a spray zone showed significant NaCl tolerance. However, in the main, responses of populations to increasing NaCl in the rooting medium showed little relationship with electrical conductivity or Na content of the soil. Narrow-sense heritability estimates were high for all populations except for one from a salt marsh and one from a spray zone. Broad-sense heritabilities were high for all populations suggesting high genetic components for variation in NaCl tolerance. (Author's abstract)
W87-05268

Group 3C—Use Of Water Of Impaired Quality

CAN WE COPE WITH SALTY WATER,
Florida Univ., Gainesville. Dept. of Ornamental Horticulture.
C. H. Peacock.
USGA Green Section Record, Vol. 24, No. 4, p 6-7, July-August 1986. 2 tab.

Descriptors: *Water pollution effects, *Saline water irrigation, *Salt tolerance, *Turf grasses, *Irrigation, Saline water, Field tests.

The time is coming when poor water quality sources will be used for turf and landscape irrigation. Recent research has focused on identifying those turf grass species and cultivars that are most tolerant of saline conditions. Species have been classified according to salt tolerance based on salt levels that cause a 50% reduction in top or root growth. Salinization was studied at a specially designed field installation where turf plots can be irrigated with salt water of varying concentrations while maintaining the turf under field conditions. Initial studies were conducted to determine the effects of saline irrigation and it was found that Tifway bermudagrass withstood the highest salinity rate of 3,500 parts per million. Several measures can be taken to mitigate the effects of saline water use, including selection of salt-tolerant species, drainage improvements, and maintenance of high water infiltration rates. (Michael-PTT)
W87-05270

EFFECTS OF WASTEWATER FROM OLIVE PROCESSING ON SEED GERMINATION AND EARLY PLANT GROWTH OF DIFFERENT VEGETABLE SPECIES,
Consejo Superior de Investigaciones Cientificas, Grenada (Spain). Dept. de Quimica Agricola y Fisiologia.
For primary bibliographic entry see Field 5C.
W87-05277

IRRIGATION MANAGEMENT FOR SOIL SALINITY CONTROL: THEORIES AND TESTS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
E. Bresler, and G. J. Hoffman.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1552-1559, November-December 1986. 8 fig, 2 tab, 18 ref.

Descriptors: *Irrigation management, *Leaching, *Saline soils, *Models studies, *Mathematical models, *Soil water, *Hydrologic budget, Agriculture, Crop yield, Grasses, Prediction, Osmosis, Transpiration, Equations.

The steady-state leaching theory and related concepts regarding soil salinity control were evaluated in view of the transient-state theories presented and recent experimental results. Data from small plot experiments to establish the leaching requirement of nine crops and from a rhizotron study on the influence of irrigation frequency on soil salinity control agreed with theoretical, transient-state predictions that consider water flow, salt transport, and water uptake by crop roots, simultaneously. Root water uptake was assumed to depend on matric (water content) and osmotic (soil salinity) potentials, and on a critical root-water potential of about -0.3 MPa. The assumption that the major effect of soil salinity is a reduction in plant water uptake was substantiated. Results show water balance components (for nine crops irrigated several times each day and for grass irrigated with various combinations of quantity, quality, and frequency) deviated significantly from predictions based on the steady-state leaching fraction equation. The deviation was attributed to an increase in soil-water content and transpiration as irrigation applications increased; or conversely, an increase in soil-water content as transpiration decreased because of increased soil salinity. The practical limitations of salinity control in irrigated agriculture based on the steady-state leaching equation were evident even for high frequency irrigation where steady-state conditions should be approached. Measured commercial yields and aboveground dry matter production compared well with yields computed on the assumption that relative crop yield is equivalent to relative transpiration. Both measured and computed results indicated that irrigation water quality and quantity, rather than irrigation frequency, influenced dry matter production of grass. (Author's abstract)
W87-05420

IRRIGATION WITH BRACKISH WATER UNDER DESERT CONDITIONS: III. METHODS FOR ACHIEVING GOOD GERMINATION UNDER SPRINKLER IRRIGATION WITH BRACKISH WATER,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Boyko Inst. for Agriculture and Applied Biology.
D. Pasternak, Y. De Malach, I. Borovic, and M. Twersky.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 335-341, December 1985. 3 tab, 9 ref.

Descriptors: *Impaired water use, *Brackish water, *Irrigation, *Sprinkler irrigation, *Deserts, *Germination, *Crop yield, Mediterranean desert, Evaporation, Leaching, Tomatoes, Salts, Salinity, Furrows, Mulching, Seedlings, Infiltration, Field capacity.

Conventional sprinkler irrigation methods used in a Mediterranean desert climate include pre-irrigation to wet the rooting zone of the soil profile to field capacity, followed by light irrigation daily during the germination period, and thereafter by the irrigation schedule appropriate for the crop and season. When brackish water is used under the high-evaporation conditions of the desert summer, the light daily irrigations during the germination period result in rapid salinization of the seedbed and in very poor germination. However, in soils with high water infiltration rates, these problems can be averted by omitting pre-irrigation, and applying all the water thus saved for leaching of the seedbed during the germination period. In a field experiment with tomatoes, the application of 215 mm brackish water (EC sub i = 4.4 dS/m) during a 10-day period after sowing on a flat surface resulted in an effective leaching of salt from the upper 5 cm soil layer and in a five-fold increase in the number of germinated seedlings compared to the conventional method of irrigation with the same water. When brackish water was used with the conventional irrigation schedule, sowing in shallow furrows tripled the number of germinated seedlings compared to sowing on a flat seedbed, and the use of a mulch of wood chips quadrupled the number of germinated seedlings compared to no mulching. (Author's abstract)
W87-05438

EFFECTS OF SALINE WATER IRRIGATION ON SOIL SALINITY, PECAN TREE GROWTH AND NUT PRODUCTION,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
For primary bibliographic entry see Field 5C.
W87-05506

SALT TOLERANCE OF TWO DIFFERENTLY DROUGHT-TOLERANT WHEAT GENOTYPES DURING GERMINATION AND EARLY SEEDLING GROWTH,
Texas Tech Univ., Lubbock. Dept. of Biological Sciences.
A. Mozafar, and J. R. Goodin.
Plant and Soil PLSOA2, Vol. 96, No. 3, p 303-316, 1986. 7 fig, 1 tab, 49 ref.

Descriptors: *Water pollution effects, *Impaired water use, *Wheat, *Plant growth, *Salt tolerance, *Seedlings, *Germination, *Drought resistance, Salts, Salinity, Ions, Specific ion effect, Osmosis, Membrane processes, Root development, Grain crops.

Osmotic and specific ion effect are the most frequently mentioned mechanisms by which saline substances reduce plant growth. However, the relative importance of the effect of both factors varies depending on the drought and/or salt tolerance of the plant under study. The effects of several single salts of Na(+) and Ca(2+) on the germination and root and coleoptile growth of two wheat (Triticum aestivum L.) cultivars, TAM W-101 and Sturdy, the former being more drought tolerant than the latter, were assessed. Significant two- and three-way interactions were observed between cultivar, kind of salt, and salt concentration for germination, growth of coleoptile and root, and root/coleoptile ratio. Data was presented which led to the conclusions that in these wheat cultivars, coleoptile and root tissues are differently sensitive to various salts, and that at the germination stage, tolerance to certain salts is higher in the more drought tolerant cultivar. (Wood-PTT)
W87-05593

INFLUENCE OF SALT STRESS ON BIOCHEMICAL PROCESSES IN CHICKPEA, CICER ARIETINUM L.,
Shivaji Univ., Kolhapur (India). Dept. of Botany.
C. V. Murumkar, and P. D. Chavan.
Plant and Soil PLSOA2, Vol. 96, No. 3, p 439-443, 1986. 4 tab, 15 ref.

Descriptors: *Water pollution effects, *Bioaccumulation, *Plant growth, *Plant physiology, *Plant tissues, *Chickpeas, *Salt tolerance, *Impaired water use, Biochemistry, Salinity, Sodium chloride, Sand, Crop yield, Seeds, Heavy metals, Starch, Proteins, Sugars, Photosynthesis, Carbon, Carbon cycle, Accumulation, Tissue analysis.

Some biochemical processes in pods of chickpea (Cicer arietinum L.) plants subjected to increasing levels of NaCl salinity in sand culture were investigated. Chickpea exhibited a marked salt sensitivity with respect to yield characteristics such as number of pods per plant, number of filled pods and 100 pod and seed weight. The accumulation of Na and Cl was more pronounced in the pod shell as compared to that in seeds. The Ca content in pod shell showed a decrease under saline conditions; an opposite trend was exhibited by P. Under saline conditions the levels of Fe, Mn and Mg were lowered in the seed tissue. The protein and starch contents of the seeds were also reduced markedly under saline conditions while only minor changes in the sugar fraction were found. Salinity favored accumulation of free proline in the pod shell as well as in the seeds. Salt stress caused reduction of photosynthetic carbon assimilation in pods with a change in pattern of carbon metabolism. (Author's abstract)
W87-05594

3D. Conservation In Domestic and Municipal Use

RESEARCH CONTRIBUTIONS TO WATER CONSERVATION TECHNOLOGIES,
Texas Agricultural Experiment Station, Lubbock.
For primary bibliographic entry see Field 3B.
W87-05239

3F. Conservation In Agriculture

IMPROVING MANAGEMENT PRACTICES ON SURFACE IRRIGATED LANDS: THE ROLE OF MODELING,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 5G.
W87-05183

SALINITY CONTROL THROUGH WATER CONSERVATION IN THE UPPER COLORADO RIVER BASIN,
Utah State Univ., Logan. Coll. of Engineering.
For primary bibliographic entry see Field 5G.
W87-05187

CASE STUDY OF A MAJOR AGRICULTURAL CONTROL PROGRAM - THE GRAND VALLEY EXPERIENCE,
Soil Conservation Service, Denver, CO.
For primary bibliographic entry see Field 5G.
W87-05191

MEASURES FOR REDUCING RETURN FLOWS FROM THE WELLTON-MOHAWK IRRIGATION AND DRAINAGE DISTRICT,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 5G.
W87-05193

DOWN TO THE VERY LAST DROP,
For primary bibliographic entry see Field 3C.
W87-05256

PROTEIN CONTENTS OF SEED YIELDS OF FIELD-GROWN SOYBEANS EXPOSED TO SIMULATED ACIDIC RAIN: ASSESSMENT OF THE SENSITIVITIES OF FOUR CULTIVARS AND EFFECTS OF DURATION OF SIMULATED RAINFALL,
Manhattan Coll., Bronx, NY. Lab. of Plant Morphogenesis.
For primary bibliographic entry see Field 5C.
W87-05264

YIELD RESPONSE OF DAVIS SOYBEANS TO SIMULATED ACID RAIN AND GASEOUS POLLUTANTS IN THE FIELD,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-05265

EMISSION OF ETHYLENE BY OAT PLANTS TREATED WITH OZONE AND SIMULATED ACID RAIN,
Pennsylvania State Univ., University Park. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5C.
W87-05266

WEATHER DEPENDENCE OF FORAGE HARVESTING OPERATIONS,
University Coll., Dublin (Ireland). Dept. of Agricultural and Food Engineering.
S. M. Ward, P. B. McNulty, and M. B. Cunney.
Agricultural and Forest Meteorology, Vol. 36, No. 2, p 145-152, December 1985. 2 fig, 1 tab, 15 ref.

Descriptors: *Weather forecasting, *Computer programs, *Forages, *Harvesting, *Rainfall, Grasses, Ireland, Crop yield, Prediction, Climates, Regional analysis.

Grass is said to have a well defined period during which harvesting should be carried out in order to optimize product quality. Thus, it is necessary to determine the probability of obtaining suitable forage harvesting weather during the harvesting season, which extends from early May to September. Typically two to three cuts are taken at 6 to 8 week intervals. Major harvesting difficulties are experienced on heavy, poor draining soils, in areas of high rainfall. The weather dependence of forage harvesting operations is discussed and the threshold rainfall values are established for field work interruption. A computer program is developed that evaluates the suitability of a given weather sequence for forage harvesting. Almost twice the number of forage harvesting days can be expected in the East vs. West coast of Ireland, in the 2nd half of May. A trade-off occurs between system power rating and crop quality. The small to medium size holder in the west of Ireland has an insufficient annual usage to justify the purchase of a high-output system, and the holder is thus subject to the dual constraints of low system output and high rainfall. (Alexander-PTT)
W87-05278

RUNOFF AND SOIL LOSS AS INFLUENCED BY TILLAGE AND RESIDUE COVER,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W87-05416

STRESS TOLERANCE AND ADAPTATION IN SPRING WHEAT,
Georgia Univ., Athens. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W87-05430

EFFECTS OF AIR TEMPERATURE AND WATER STRESS ON APEX DEVELOPMENT IN SPRING WHEAT,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2I.
W87-05431

CANOPY TEMPERATURE BASED IRRIGATION SCHEDULING INDICES FOR KENTUCKY BLUEGRASS TURF,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
C. S. Throssell, R. N. Carrow, and G. A. Milliken.
Crop Science CRPSAY, Vol. 27, No. 1, p 126-131, January-February 1987. 6 fig, 1 tab, 17 ref.

Descriptors: *Canopy temperature, *Irrigation scheduling, *Turf management, *Turf grasses, *Soil water potential, *Evapotranspiration, Field tests, Water use, Irrigation, Model studies.

Techniques currently used by turf managers to schedule irrigations promote overwatering, causing the inefficient use of water resources. The plant canopy temperature-ambient air temperature differential is a good indicator of the water status of a plant. Field experiments were conducted to assess the potential of using plant canopy temperature, measured with an infrared thermometer, to schedule irrigations for Kentucky bluegrass (Poa pratensis L.) turf and to develop preliminary information to use stress degree day (SDD), crop water stress index (CWSI), and critical point model (CPM) indices to schedule irrigations. Data were collected in the summer and fall of 1983 from differentially irrigated plots. Treatments were: (i) well watered-irrigation at soil water potential of -0.04MPa; (ii) slightly stressed-irrigation at soil water potential of -0.07 MPa; and (iii) moderately stressed-irrigation at soil water potential of -0.40 MPa. Variables were measured daily and included canopy temperature, ambient air temperature, solar radiation, vapor pressure deficit, open pan evaporation, wind speed, soil water potential, volumetric water content, number of days after irrigation, and the number of days after mowing. The data were used to develop the irrigation scheduling indices that were evaluated in 1984. Each of the indices was compared to tensiometer based irrigation scheduling at -0.07 MPa soil water potential. During a 25-day period of hot, dry weather in 1984, water use and number of irrigation events (in parenthesis) were 98 (7), 112 (8), 140 (10), and 210 mm (15 times), respectively, for irrigation scheduling by tensiometer, SDDpos, CWSI, and CPM. Shoot density, verdure, and root weight were not significantly different for the treatments, but visual quality was higher for the CPM and CWSI treatments-reflecting the greater amount of water applied. Further refinement of these indices could allow them to be useful tools for irrigation scheduling. (Author's abstract)
W87-05432

IRRIGATION SCHEDULING EFFECTS ON YIELD AND PHOSPHORUS UPTAKE OF COWPEA,
Ministry of Agriculture, Jos (Nigeria).
M. N. Tyem, and S. T. Chieng.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 343-355, December 1985. 6 fig, 5 tab, 15 ref.

Descriptors: *Sprinkler irrigation, *Irrigation, *Plant growth, *Water conservation, *Cowpea, *Fertilizers, *Irrigation practices, *Crop yield, Fertilization, Water level, Phosphorus, Dry matter, Irrigating efficiency, Statistical analysis, Mathematical studies, Bioaccumulation, Nutrients, Comparison studies.

A line-source sprinkler irrigation system was used for irrigation-fertilizer cowpea (Vigna unguiculata (L.) Walp.) production studies. The relative merits and demerits of irrigating frequently but with smaller amounts of water than the design water application depth as compared to stage-of-growth and normal interval irrigation were investigated with five levels of fertilizer P, three water levels and five irrigation schedules. Dry matter production on the basis of forage produced was used as the yield indicator. The plants were harvested when the more advanced individuals reached the late boot stage immediately preceding the appearance of their inflorescences. P uptake was also measured. Statistical analysis of yield and P uptake gave a positive response of the crop to added fertilizer and irrigation water. Application of 70 kg/ha P2O5 produced the highest yields under all irrigation schedules. Irrigating too frequently was found to be detrimental; maximum yield under P fertilization was obtained with irrigations scheduled at half the design interval and with half of the design irrigation depth. Uptake of P increased with yield. (Author's abstract)
W87-05439

RESPONSE OF WHEAT TO IRRIGATION WITH SMALL AMOUNTS OF WATER APPLIED IN VARIOUS WAYS,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
T. N. Chaudhary.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 357-364, December 1985. 3 fig, 4 tab, 4 ref.

Descriptors: *Irrigation, *Wheat, *Irrigation practices, *Surface irrigation, *Furrow irrigation, *Irrigation efficiency, *Crop yield, *Water use efficiency, India, Loam, Agriculture, Root development, Field tests, Plant growth, Grain crops, Soil types, Comparison studies, Performance evaluation.

In dry land agriculture, crop failure is often due to dry seedbeds which hamper crop stand establishment and root growth. Irrigation with small amounts of water may make the difference between success and failure of the crop. A 2-year field study on a sandy loam soil evaluated the response of wheat to irrigation with 4-60 mm water applied in various ways. An amount of 4 or 6 mm water applied in the furrow enhanced above-ground plant growth, root growth, grain yield and water use considerably compared to the same amount of water surface applied to seeded rows. With surface irrigation of 40 or 60 mm water, crop growth and grain yield increased further; however, a significantly higher grain yield was obtained with post-seeding rather than pre-seeding irrigation. (Author's abstract)
W87-05440

LEACHING REQUIREMENT OF IRRIGATED SOILS,
Darling Downs Inst. of Advanced Education, Toowoomba (Australia). School of Engineering.
R. J. Smith, and N. H. Hancock.
Agricultural Water Management AWMADF, Vol. 11, No. 1, p 13-22, March 1986. 2 fig, 1 tab, 13 ref.

Descriptors: *Leaching, *Irrigation, *Irrigation practices, *Leaching requirements, *Mathematical equations, *Model studies, Salts, Irrigation water, Drainage systems, Mathematical studies, Soil water, Salinity.

The importance of maintaining acceptably low salt levels in irrigated soils is well recognized. Current guidelines for the calculation of the leaching requirement (LR) for the leaching of salts imported with irrigation water are demonstrably inadequate and have been generally shown to result in an over-estimate of the LR. This results in the application of excessive amounts of water as irrigation and increased salt loads in the drainage system. The methods available for the estimation of LR are reviewed and their inadequacies discussed. The basic concept of leaching is reanalyzed and a simple physically based equation is developed which involves only the concentration of the applied water, C sub i, and a desired soil-water salinity, C sub a*: C sub a*/C sub i = ln(LR)/(LR - 1). As this equation is independent of the pattern of plant water use, it is of general application and it is concluded that the equation provides a better

method of estimating the leaching requirements than the current guidelines. (Author's abstract)
W87-05441

OPTIMAL OPERATION SCHEDULE OF IRRIGATION DISTRIBUTION SYSTEMS,
Water and Land Management Inst., Aurangabad (India).
A. R. Suryavanshi, and J. M. Reddy.
Agricultural Water Management AWMADF, Vol. 11, No. 1, p 23-30, March 1986. 2 fig, 1 tab, 4 ref.

Descriptors: *Irrigation, *Optimization, *Irrigation operation, *Irrigation efficiency, *Irrigation design, *Irrigation engineering, Irrigation practices, Irrigation programs, Irrigation requirements, India, Outlets, Channels, Mathematical equations, Mathematical studies.

The 'constant frequency-variable depth' method of water delivery is discussed. The problem of clustering and sequencing outlets on a distributary channel to deliver the required quantity of water is described and formulated as a zero-one linear programming problem. The optimal operation schedule of the outlets was obtained for distributary 3 of the Meena branch canal in the Kukadi Irrigation Project in Maharashtra, India. (Author's abstract)
W87-05442

WITHIN-ROW IRRIGATION SAVES WATER ON CROPLANDS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
W. W. Rasmussen, and R. D. Berg.
Agricultural Water Management AWMADF, Vol. 11, No. 1, p 31-37, March 1986. 3 fig, 2 tab, 2 ref.

Descriptors: *Furrow irrigation, *Irrigation, *Water conservation, *Irrigation design, *Cropland, *Beans, *Crop yield, Soil erosion, Conservation, Erosion, Irrigation efficiency, Irrigation practices, Water use, Idaho, Loam, Cultivated lands, Agriculture.

Excessive water use and soil erosion from furrow irrigation are two of the most serious management problems on irrigated silt loam soils in southern Idaho, U.S.A. These problems are especially serious on croplands planted to dry beans. In conventional bean production, fields are irrigated before planting to wet the entire soil surface. It is not unusual for farmers to apply as much as 30 cm of water over the entire field during a single preplanting irrigation. Results from this study showed that planting beans in the bottom of pre-irrigated furrows without soaking completely between the furrows reduced preplanting water application by 60%. The continuing within-row treatments reduced irrigation water use by 42% compared to the conventional irrigation practices. Total bean yields on the preplanting, within-row treatments were not significantly different from the conventional treatments. (Author's abstract)
W87-05443

QUASI-STEADY STATE INTEGRAL MODEL FOR CLOSED-END BORDER IRRIGATION,
R. S. Ram, V. P. Singh, and S. N. Prasad.
Agricultural Water Management AWMADF, Vol. 11, No. 1, p 39-57, March 1986. 4 fig, 31 ref. NSF Project NSF-ENG-79-23345.

Descriptors: *Border irrigation, *Irrigation, *Model studies, *Mathematical models, *Infiltration, Mathematical equations, Mathematical studies, Comparison studies, Experimental data, Infiltration rate, Infiltration capacity, Recession, Bed roughness, Performance evaluation.

A quasi-steady state integral (QSSI) model was developed for irrigation on closed-end (CE) borders. A semi-analytical method was used for solving the governing equations. The model results compared favorably with experimental data from 18 experimental CE borders. The absolute average percent deviation (ADP) between calculated and observed advance times varied between 5.3 and 28.5. The ADP for recession times varied between 1.0 and 37.3. The calculated advance times were found to be consistently smaller than observed values for these borders. For constant infiltration parameters, the border bed roughness was found to be the single most important parameter affecting model results. (Author's abstract)
W87-05444

WATER LOSSES THROUGH THE BUNDS OF IRRIGATED RICE FIELDS INTERPRETED THOUGH AN ANALOGUE MODEL,
Land Resources Development Centre, Surbiton (England).
S. H. Walker, and K. R. Rushton.
Agricultural Water Management AWMADF, Vol. 11, No. 1, p 59-73, March 1986. 9 fig, 4 tab, 11 ref.

Descriptors: *Basin irrigation, *Irrigation, *Groundwater level, *Model studies, *Irrigation efficiency, *Rice, *Bunds, *Water use efficiency, *Field tests, Agriculture, Irrigation design, Irrigation water, Percolation, Water use, Water table, Analog computers, Computers.

In many countries where rice is grown by basin irrigation, under continuous flow and with a ground water table at depths of 1 m or greater, field water use efficiencies of only 25-30% are measured. The principal loss is caused by lateral percolation, the movement of water from the flooded fields laterally into the bunds and thence vertically down to the water table. Typical field evidence is quoted, and water movement in the vicinity of the field boundary is studied by means of a resistance network analog computer. The results show that field water use efficiencies can be greatly increased by sealing the bunds or by maintaining the shallowest possible water layer in the rice fields. (Author's abstract)
W87-05445

WATER REQUIREMENT FOR IRRIGATED RICE IN A SEMI-ARID REGION IN WEST AFRICA,
Agricultural Univ., Wageningen (Netherlands). Dept. of Civil Engineering and Irrigation.
J. M. H. Hendrickx, N. H. Vink, and T. Fayinke.
Agricultural Water Management AWMADF, Vol. 11, No. 1, p 75-90, March 1986. 3 fig, 9 tab, 17 ref.

Descriptors: *Irrigation, *Evapotranspiration, *Evapotranspiration potential, *Soil profiles, *Soil types, *Semiarid climates, *Rice, *Water use, West Africa, Loam, Clays, Rainfall, Infiltration rate, Infiltration, Crop coefficients, Lysimeters, Moisture meters.

The water requirement of rice (Oryza sativa L.) in the areas of the Office du Niger (Niono, Republic du Mali, West Africa) was determined. Average annual rainfall is 600 mm and evapotranspiration exceeds precipitation in every month except August. Alluvial soils vary in texture from heavy clay to sandy loam and have very low infiltration rates. The water use of rice was measured by establishing the water balance of four irrigation units varying in size from 12 to 26 ha. Evapotranspiration was evaluated with 'non-weighing' lysimeters and varied in 1980 from 5.3 mm/day shortly after flooding and 7.1 mm/day during heading to 4.1 mm/day at ripening. The crop coefficients found do not always correspond to those presented by Doorenbos and Pruitt (1977). The crop coefficient depended strongly on the soil cover and was 1.0 for 10-70% soil cover and increased linearly to 1.25 for 100% soil cover. This relationship between soil cover and crop coefficient can be used to improve the estimates of rice evapotranspiration from large irrigation units with incomplete soil cover. The peak evapotranspiration may be as high as 7.8 mm/day during a 10-day period under full soil cover. The peak water requirement during the period of dry land preparation does not exceed 6 mm/day on level fields. The amount of water needed to saturate the soil profile after the dry season varied from 122 to 302 mm. A significant difference was measured between the pre-irrigation gift on a level field (175 mm) and on a non-level field (255 mm), which indicates the importance of levelling. (Author's abstract)
W87-05446

WATER HARVESTING FOR RECLAIMING ALKALI SOILS,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 4A.
W87-05449

TRICKLE IRRIGATION OF COTTON: EFFECT ON SOIL CHEMICAL PROPERTIES,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
H. I. Nightingale, K. R. Davis, and C. J. Phene.
Agricultural Water Management AWMADF, Vol. 11, No. 2, p 159-168, April 1986. 3 fig, 4 tab, 15 ref.

Descriptors: *Trickle irrigation, Irrigation, *Furrow irrigation, *Cotton, *Soil chemistry, *Irrigation effects, Saline soils, Salinity, Clay loam, California, Field tests, Water requirements, Irrigation requirements, Evaporation, Irrigation water, Irrigation practices, Conductivity, Groundwater, Sodium compounds, Root zone, Crop yield.

The management of soil salinity and sodicity in the root zone (0-150 cm) of Panoche clay loam soil was studied during three consecutive growing seasons in a field experiment designed to determine the water requirement of Acala SJ-2 cotton (Gossypium hirsutum L.) under trickle irrigation on the western San Joaquin Valley of California. The trickle irrigation treatments (20, 40, 60, 80, and 100% of the previous day's pan evaporation, PE) were imposed on each of three preplant furrow irrigation depths of 0, 190 and 380 mm. The electrical conductivity, EC, of the irrigation water ranged from 0.4 to 0.5 dS/m unless groundwater had to be mixed with the surface supply; this practice raised the EC to 0.6-0.9 dS/m for short time periods. The unadjusted sodium adsorption ratio, SAR, of the irrigation water averaged < 4. Soil salinity, as measured by EC sub e, was < 5 dS/m and sodicity, as measured by SAR sub e, was < 15 in the root zone. Changes in these soil chemical properties were more related to the amount of preplant irrigation at the lower ($< 40\%$ PE) trickle-irrigation levels than at the higher levels. Results suggest that soil salinity and sodicity can be maintained at acceptably low levels by appropriate preplant irrigation with consideration to the amount of winter rainfall; even when during the season only sufficient trickle irrigation is given to meet the crop water requirements without regard to leaching needs. The lint cotton yields over the 3-year period ranged from 357 to 1542 kg/ha; the corresponding applied water ranged from 175 to 744 mm. (Author's abstract)
W87-05452

WATER PRODUCTION FUNCTION OF SORGHUM FOR NORTHEAST BRAZIL,
Inter-American Inst. for Cooperation on Agriculture, Petrolina (Brazil).
P. N. Sharma, and F. B. A. Neto.
Agricultural Water Management AWMADF, Vol. 11, No. 2, p 169-180, April 1986. 2 fig, 7 tab, 8 ref.

Descriptors: *Water use efficiency, *Water use, *Sorghum, *Irrigation, *Nitrogen, *Water requirements, *Crop yield, *Irrigation effects, Regression analysis, Mathematical studies, Mathematical equations, Statistical analysis, Irrigation efficiency, Evaporation, Fertilizers, Nutrients.

The results of an experiment to determine the water production function of sorghum for Northeast Brazilian conditions are reported. The experiment was designed in two random blocks consisting of four growth stages for irrigation deficit and four levels of nitrogen. The crop response to water was found to be of quadratic nature. Regression coefficients were developed for each nitrogen and growth stage treatment between water use and grain yields. The most critical stage was found to be the vegetative stage followed by flowering and grain formation stages. The yield response factors as according to Doorenbos and Kassam were found to vary drastically not only with different nitrogen levels and crop growth stages but also with different irrigation levels. A modified linear equation was suggested. The coefficients of this modified equation was determined for all four

stages and for the four nitrogen levels for sorghum. The highest average water use efficiency of 109.3 kg/ha/cm of water and highest obtainable grain yield of 4.92 t/ha was found to be at 425 mm of water use and 45 kg/ha of nitrogen. The crop coefficients (K sub c) to compute crop water use from pan evaporation vary between 0.4 and 0.81 with an average for the whole growing period of 0.75. (Author's abstract)
W87-05453

EFFECTS OF FREQUENCY OF IRRIGATION AND GYPSUM TREATMENT ON LEAF WATER POTENTIAL AND LEAF STOMATAL CONDUCTANCE OF LUCERNE (MEDICAGO SATIVA L.) GROWN ON A HEAVY CLAY SOIL,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
G. C. Wright, D. M. Whitfield, O. A. Gyles, and A. J. Taylor.
Irrigation Science IRSCD2, Vol. 7, No. 2, p 73-82, 1986. 6 fig, 4 tab, 36 ref.

Descriptors: *Irrigation effects, *Irrigation scheduling, *Land disposal, *Leaves, *Water potential, *Stomatal conductance, *Lucerne, *Plant growth, Osmosis, Soil moisture deficit, Turgor, Crop yield, Productivity.

Both water shortages and increasing salinization, arising from over-irrigation, affect the productivity of lucerne grown in the Goulburn Valley Irrigation Area, Victoria, Australia. Irrigation management needs to be improved to maximise production and to increase crop water-use efficiency. Concurrent diurnal measurements of water potential, osmotic potential and conductance were made on leaves of lucerne grown under weekly (W) and fortnightly (F) irrigation on gypsum-treated (G) and untreated soil (C). Measurements were made throughout the period of vegetative growth. Leaf water potentials were lower both at dawn and in the afternoon under fortnightly as compared to weekly irrigation. Gypsum application led to a slower decline in water potential under fortnightly irrigation, although the effect was small compared with more frequent irrigation. Stomatal conductance was reduced under treatments F sub G and F sub C during the later stages of vegetative growth, coinciding with leaf water potentials of less than c. -1.6 MPa. The relationship between leaf water potential and turgor potential changed with time such that positive turgor was maintained as leaf water potential declined. Turgor maintenance was achieved through a decrease in leaf osmotic potential. These data suggest that lucerne is capable of osmotic adjustment. Stomatal conductance declined rapidly below a leaf turgor potential of c. 0.1 MPa. It is hypothesised that osmotic adjustment enabled stomatal adjustment, which contributed to continued assimilation despite increasing soil moisture deficits. (Alexander-PTT)
W87-05505

QUASI-STEADY STATE INTEGRAL MODEL FOR BORDER IRRIGATION,
R. S. Ram, V. P. Singh, and S. N. Prasad.
Irrigation Science IRSCD2, Vol. 7, No. 2, p 113-141, 1986. 17 fig, 4 tab, 30 ref. NSF Project NSF-ENG-79-23345.

Descriptors: *Mathematical models, *Hydrodynamic models, *Model studies, *Comparison studies, *Performance evaluation, *Border irrigation, *Irrigation, *Recession, Infiltration, Bed roughness, Equations, Drainage.

There exists a multitude of hydrodynamic models for border irrigation. A recent study by Ram et al. (1983) surveys these models. Specifically, kinematic wave models were reviewed by Singh and Ram (1983). For the sake of completeness, a brief review of only zero inertia (ZI) models is given here. A quasi-steady state integral (QSSI) model was developed for irrigation on freely draining borders. A semi-analytical method was used for solving the governing equations. The model results compared favorably with experimental data from 13 experimental borders for advance and from 4 experimental borders for recession. The absolute average percent deviation (APD) between calculated and observed advance times varied between 13.1 and 26.6 for 4 data sets and between 9.2 and 18.8 for 9 data sets. The APD for recession times varied between 1.7 and 5.7 for 4 data sets. The calculated advance times were smaller than observed values for these borders. For constant infiltration parameters, the border bed roughness was found to be the single most important parameter affecting model results. (Alexander-PTT)
W87-05509

FURROW MODEL WITH SPATIALLY VARYING INFILTRATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2G.
W87-05528

STOCHASTIC IMPACTS ON FARMING: II. SEASONALLY CONTINUOUS PROBABILITY DISTRIBUTIONS,
W. M. Snyder, and A. W. Thomas.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1017-1025, July-August 1986. 7 fig, 4 tab, 22 ref.

Descriptors: *Model studies, *Stochastic process, *Decision making, *Management planning, *Farming, *Agriculture, *Risk assessment, *Probability distribution, Rainfall, Temperatures, Stream flow, Climates, Boundary conditions, Agronomy.

Many farming activities are dependent on seasonal patterns of rainfall, temperature, streamflow, and other climatological variables. In order to establish levels of risk of these variables to aid in planning farm activities a method was developed for calculating continuous seasonal cycles of probabilities for values of the variables. The probabilities are defined by a mathematical surface based on magnitude of event and month of the year. This surface is a modification of the form-free two-dimensional sliding polynomials. Data consisted of one observation per month for each year of record. These data were standardized using a separate monthly variate transform based on the first three moments for each month. The probability surface was evaluated by least-square smoothing of the twelve months simultaneously. Smoothing was constrained by imposition of boundary conditions for extreme magnitude and for maintenance of full seasonal cyclic continuity. The methodology was tested on long-term monthly data that included total rainfall, total EI, daily maximum streamflow and daily minimum streamflow. The seasonal variation of natural risk for each variable was defined quantitatively and presented in a manner to demonstrate how the information in these seasonal patterns supports many existing agricultural practices. Many of these common practices were developed through years of experimentation; however, with the capability to capture more information from historical records the farmer has the opportunity to improve and refine farming operations with known levels of risk. (See also W87-05530) (Author's abstract)
W87-05529

STOCHASTIC IMPACTS ON FARMING: III. SIMULATION OF SEASONAL VARIATION OF CLIMATIC RISK,
Agricultural Research Service, Watkinsville, GA.
A. W. Thomas, and W. M. Snyder.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1026-1031, July-August 1986. 6 fig, 1 tab, 11 ref.

Descriptors: *Model studies, *Stochastic process, *Decision making, *Management planning, *Farming, *Risk assessment, *Probability distribution, *Seasonal variation, *Climates, Simulation, Agriculture.

Synthetic data sets were simulated for the generation of information to aid in planning for stochastic impacts on farming. In the first phase the derivation of form-free seasonally continuous probability distributions established the stochastic characteristics of climatological variates that include seasonal cycles. In this second phase simulation converts these characteristics into utilitarian expressions of risk and uncertainty. Such simulation is necessary since simple statistical distributions are not always usable to represent meterological and hydrologic variates. Form-free distributions that are substitutes contain estimates of model error which must be reflected in calculations of risk and uncertainty. Simulation provides acceptable approximations in a straightforward manner. Simulation must be specifically designed to address the particular planning problem. In particular, the length of the synthetic samples must correspond to the length of the economic planning period covered by the analysis of risk. Also, the number of such samples generated must express the confidence with which statements are made about the levels of risk. Large numbers of samples must be generated for high levels of confidence typically associated with structural designs where loss of life may be involved. Smaller numbers of samples can be used satisfactorily for planning agricultural activities where high levels of confidence are not required. (See also W87-05529) (Author's abstract)
W87-05530

ENGINE EFFICIENCIES IN IRRIGATION PUMPING FROM WELLS,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 8C.
W87-05533

BIDIRECTIONAL UNIFORMITY OF WATER APPLIED BY CONTINUOUS-MOVE SPRINKLER MACHINES,
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. R. Hanson, and W. W. Wallender.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1047-1053, July-August 1986. 12 fig, 2 tab, 6 ref.

Descriptors: *Sprinklers, *Irrigation patterns, *Performance evaluation, *Nozzles, Discharge, Irrigation.

Uniformity of water applied along the travel path and along the lateral was measured for a linear-move and a center-pivot sprinkler machine. High uniformity occurred near the guide towers, which had very constant movement, and low uniformity occurred near the middle towers, which had very irregular movement, for both machines. With one exception, however, correlation between variability of tower movement and variability of catch-can data was weak. We also found no correlation between nonuniformity along the lateral and variability in the nozzle discharges. Nonuniformity along the lateral appeared related to the movement of the towers. (Author's abstract)
W87-05534

PREDICTING SEASONAL IRRIGATION WATER REQUIREMENTS ON COARSE-TEXTURED SOILS,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W87-05535

SYSTEM FOR MEASURING INFILTRATION RATES UNDER CENTER-PIVOT IRRIGATION SYSTEMS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
G. L. Kelso, and J. R. Gilley.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1058-1064, July-August 1986. 6 fig, 3 tab, 5 ref.

Descriptors: *Measuring instruments, *Infiltrometers, *Infiltration, *Irrigation systems, *Runoff, Performance evaluation, Sprinklers, Spray nozzles, Water level, Irrigation, Canopy, Tillage, Field tests.

A system for measuring the application rate, potential runoff and the soil infiltration rate under center-pivot irrigation systems was developed. The

infiltrometer is similar to the Purdue-Wisconsin type with improvements to increase the utility, portability and accuracy of the apparatus. The primary improvements in the system are the addition of an electronic water level sensor and a digital data logging system. The experimental procedures developed for using these instruments under a center-pivot irrigation system are also described. Results of tests for the various types of sprinkler packages and spray nozzles are presented to demonstrate the use of the infiltrometer. The performance of the individual components was satisfactory and the vacuum infiltrometer provided a measure of the potential runoff under the center-pivot irrigation systems. (Author's abstract)
W87-05536

CROP WATER USE DATA AVAILABLE FROM THE SOUTHEASTERN USA,
Agricultural Research Service, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
For primary bibliographic entry see Field 6D.
W87-05537

OSCILLATING PRESSURE FOR IMPROVING APPLICATION UNIFORMITY OF SPRAY EMITTERS,
California Univ., Davis. Dept. of Agricultural Engineering.
D. J. Hills, R. C. M. Silveira, and W. W. Wallender.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1080-1085, July-August 1986. 12 fig, 3 tab, 8 ref.

Descriptors: *Irrigation systems, *Oscillating pressure, *Spray emitters, *Optimization, Performance evaluation, Irrigation, Agriculture, Wetting.

Oscillating pressure was assessed for improving application uniformity of four spray emitters (two makes of serrated sprayers and two makes of spinners) operating at low pressures. For all emitters tested, a sinusoidal oscillation of between 0 and 103 kPa (0 to 15 psi) over a one minute cycle provided an equivalent or better Christiansen's coefficient of uniformity than did operation at a steady pressure of 207 kPa (30 psi). Operation of the two spinners in the lower pressure regime decreased the wetter diameter approximately 15%. Similarly, the equivalent wetted diameters for the two serrated sprayers decreased by approximately 33%. The effects of pressure oscillation on emission uniformity (EU) for level terrain appear to be small. In a 0% slope lateral design the EU's calculated for pressures of 228 kPa steady, 103 kPa steady, and 0-103 kPa oscillating were 92.2%, 91.5%, and 91.1%, respectively. (Author's abstract)
W87-05538

WATER-TABLE LEVEL EFFECT ON THE YIELD OF IRRIGATED AND UNIRRIGATED GRAIN MAIZE,
Consiglio Nazionale delle Ricerche, Naples (Italy). Irrigation Inst.
For primary bibliographic entry see Field 2G.
W87-05539

RESPONSE OF LEAF GROWTH, LEAF NITROGEN, AND STOMATAL CONDUCTANCE TO WATER DEFICITS DURING VEGETATIVE GROWTH OF FIELD-GROWN SOYBEAN,
Commonwealth Scientific and Industrial Research Organization, Winnellie (Australia). Darwin Labs.
R. C. Muchow, T. R. Sinclair, J. M. Bennett, and L. C. Hammond.
Crop Science CRPSAY, Vol. 26, No. 6, p 1190-1195, November-December 1986. 2 fig, 7 tab, 11 ref.

Descriptors: *Soybeans, *Plant growth, *Nitrogen, *Soil-water-plant relationships, Senescence, Tissue analysis, Shading, Photosynthesis, Stomatal transpiration, Plant physiology.

Changes in leaf area development, leaf N content, and stomatal conductance were examined in field-grown soybean in response to soil water deficits imposed during vegetative growth after canopy closure. The consequences of these changes for biomass accumulation were assessed in terms of the amount of photosynthetically active radiation (PAR) intercepted by the crops and the efficiency of its use to accumulate biomass (biomass accumulation efficiency: BAE). Mild water deficits decreased leaf expansion more than leaf production, whereas leaf senescence was similar to that in the well-watered control. However, the decrease in leaf area development was insufficient to have an impact on PAR interception, but BAE was decreased. The decrease in BAE was associated with lower stomatal conductance, whereas specific leaf N content, a determinant of long-term photosynthetic capacity, was unaffected. In contrast, severe winter deficits decreased both the amount of PAR intercepted and BAE. Accelerated leaf senescence was much more significant in decreasing PAR interception than the decrease in leaf expansion and production. Specific leaf N content actually increased under severe water deficits but, given the extremely low stomatal conductances, had no effect on crop biomass accumulation. (Author's abstract)
W87-05590

CADMIUM AND ZINC INFLUX CHARACTERISTICS BY INTACT CORN (ZEA MAYS L.) SEEDLINGS,
Auburn Univ., AL. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 5B.
W87-05591

ANATOMICAL, MORPHOLOGICAL, AND PHYSIOLOGICAL RESPONSES OF ALFALFA TO FLOODING,
California Univ., Riverside. Dept. of Plant Pathology.
D. M. Zook, D. C. Erwin, and L. H. Stolzy.
Plant and Soil PLSOA2, Vol. 96, No. 2, p 293-296, 1986. 2 fig, 13 ref.

Descriptors: *Flood irrigation, *Alfalfa, *Plant growth, *Plant morphology, *Flooding, *Root development, Flood damage, Floods, Roots, Leaves, Oxygen.

Flooding of alfalfa plants (3 wk old), resistant (A77-10B) and susceptible (Moapa 69) to Phytophthora megasperma f. sp., medicagnis (Pmm) for 4-days caused an increase in length (2 cm) of tap roots, cessation of secondary growth, suppression of lateral root growth, and formation of aerenchyma channels in the stele and hypertrophied lenticels, which extended to the stele, on taproots. In soil containing plants from which foliage had been clipped, flooding induced a decrease in O2 from 21 to 2% by the second day, and caused death of plants. In soil containing intact unclipped plants flooding induced a slight decrease in O2 to 15 to 17% which returned to normal by the fourth day. (Author's abstract)
W87-05592

RYEGRASS ESTABLISHMENT AND YIELD IN RELATION TO PESTICIDE TREATMENT, IRRIGATION AND FERTILIZER LEVEL,
Rothamsted Experimental Station, Harpenden (England).
A. M. Spaull, R. O. Clements, M. S. Rideout, and P. G. Mewton.
Annals of Applied Biology AABIAV, Vol. 109, No. 2, p 353-363, October 1986. 1 fig, 9 tab, 22 ref.

Descriptors: *Crop yield, *Plant growth, *Ryegrass, *Grasses, *Irrigation, *Irrigation effects, *Fertilizers, *Fungicides, *Pesticides, *Insecticides, *Molluscicides, *Plant diseases, Plant pathology, Fertilization, Diseases.

The effects of irrigation, four fertilizer rates, fungicide, insecticide, molluscicide, and nematocide treatments were tested on Italian Ryegrass sward sown in May 1983, in a multi-factorial experiment that allowed treatment interactions to be examined. Pests and fungal diseases were monitored over a 2-year period. In the first year yields were increased most by irrigation. There was also a large yield response to fertilizers, but only a small response to pesticide application. There were significant yield responses in the first year to nematocide and to insecticide/molluscicide treatments. Yields in the second year were affected more by increased fertilizer use than by irrigation; increases after pesticide use were similar to the previous year, and there was a small but significant gain over untreated plots at the second harvest from those treated with fungicide. It was concluded that irrigation had the greatest effect on yields of spring-sown ryegrass during its establishment year, but that increasing fertilizer rates had a greater effect the year after; that fungi had little effect on ryegrass yields, and that nematodes were more important pests than insects during establishment but insects were more important subsequently. (Author's abstract)
W87-05614

EFFECT OF SIMULATED ACID RAIN ON GROWTH AND YIELD OF VALENCIA ORANGE, FLORADADE TOMATO AND SLASH PINE IN FLORIDA,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5C.
W87-05647

CANOPY TEMPERATURE OF SUGARCANE AS INFLUENCED BY IRRIGATION REGIME,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
For primary bibliographic entry see Field 2I.
W87-05872

COMPUTER-ASSISTED MAPPING OF IRRIGATION WATER REQUIREMENTS FOR VANCOUVER ISLAND BASED ON SOIL AND AGRICULTURAL CAPABILITY SURVEY DATA,
British Columbia Ministry of Environment, Victoria. Water Management Branch.
N. K. Nagpal, M. W. Sondheim, and C. H. Wallis.
Canadian Journal of Soil Science CJSSAR, Vol. 66, No. 3, p 471-480, August 1986. 1 fig, 5 tab, 10 ref.

Descriptors: *Irrigation, *Irrigation engineering, *Irrigation requirements, *Computers, *Mapping, Irrigation efficiency, Irrigation practices, Irrigation programs, Algorithms, Model studies.

Accurate estimates of volumetric irrigation requirements are needed for regional water allocation planning on the eastern coastal lowland of Vancouver Island. Methodology is presented for computer assisted mapping of volumetric irrigation water requirements. Soil and agricultural capability maps at 1:20,000 scale were digitized and the corresponding field and laboratory data were stored in a computer mapping system. An algorithm generates the volume of water required for each polygon by multiplying an area by a depth. The area is the number of arable hectares in the polygon, The depth is calculated as a weighted average of the individual irrigation depths for the arable soils within the polygon, where arability is tied to the attributes of each soil as compared to agricultural capability criteria. Using a water requirement model, the irrigation depth for a given soil is defined as a function of available water storage capacity, estimated to an assumed rooting depth for various crops, or to a root restricting layer; level of risk; and depth to the water table. On the resulting maps, polygons needing water are displayed , with a label depicting the required volume. Tabular summaries are provided on a polygon and mapsheet basis. The relative effects of using different definitions of arability (either agricultural capability classes 1 through 4 or agricultural capability classes 1 through 5), different rooting depths (0.5 or 1.0 m, depending upon proposed crops), and different levels of risk (one of 10, 20, or 50%) can be assessed by developing a set of scenarios. (Authors' abstract)
W87-05878

INFLUENCE OF IRON SOURCE ON THE WATER-HOLDING PROPERTIES OF POT-

TING MEDIA AMENDED WITH WATER-ABSORBING POLYMERS,
Victoria Dept. of Agriculture and Rural Affairs, Ferntree Gully (Australia). Horticultural Research Inst.
E. A. James, and D. Richards.
Scientia Horticulturae SHRTAH, Vol. 28, No. 3, p 201-208, April 1986. 4 fig, 1 tab, 7 ref.

Descriptors: *Iron, *Water absorption, *Polymers, *Hydrogels, *Soil water, *Potting media, *Growth media, *Water retention, *Irrigation, Marigolds.

Incorporation of water-absorbing polymers (hydrogels) into potting media has been promoted as a method for increasing the interval between irrigations for container-grown plants. However, hydrogel performance can be influenced by ambient conditions. The two hydrogels tested were Igetagel P(R) and Terrasorb 200(R). Both are self-crosslinked insoluble solids. Four iron sources were tested: iron sulfate, Micromax(R), GU49(R), and Sequestrene 138(R). Pot experiments were conducted using either coarse, washed river sand, or a pine bark-based mix. Gel absorbencies were tested by mixing 1 g of unhydrated gel with 500 g distilled water or iron solution. The mixture was allowed to stand and then excess water was drained. Gels were thoroughly mixed with potting media at levels of 0, 1, 2, or 4 kg per cubic m. Marigold seedlings were potted into sand mixes and amended with gels. In these experiments only Micromax or Sequestrene 138 were used. Hydrogel absorbence and media water-retention were severely reduced by iron sources producing hydrated ionic species. Chelated iron was less detrimental to water retention and delayed wilting of marigolds compared to other iron sources. Both gels tested were ineffective at the recommended levels for improving time to wilting of marigolds in sand. (Main-PTT)
W87-05883

EFFECTS OF IRRIGATION FREQUENCY AND SCHEDULING ON FRUIT PRODUCTION AND RADIAL FRUIT CRACKING IN GREENHOUSE TOMATOES IN SOIL BEDS AND IN A SOIL-LESS MEDIUM IN BAGS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
J. D. Abbott, M. M. Peet, D. H. Willits, D. C. Sanders, and R. E. Gough.
Scientia Horticulturae SHRTAH, Vol. 28, No. 3, p 209-217, April 1986. 1 fig, 6 tab, 16 ref.

Descriptors: *Irrigation frequency, *Growth media, *Irrigation effects, *Fruit production, *Tomatoes, *Fruit cracking, Soil-less growth media, Drip irrigation, Tensiometers, Crop production, Irrigation, Fruit crops.

The effects on yield and radial fruit cracking of two media (soil in beds and soil-less medium in bags) and two drip-irrigation frequencies (once and four times daily) were determined for four greenhouse tomato cultivars. For plants grown in soil-less medium, two tensiometer-controlled, drip-irrigation scheduling methods were compared. Michigan-Ohio hybrid fruit cracked significantly more than the three other cultivars, but did not differ in production of total and No. 1 fruit. The amount and severity of fruit cracking was least from the soil-less, bag cultured plants. Total mean fruit weight was greatest from soil-grown plants. Although no differences in cracking occurred in the fruit from soil-less, bag-cultured plants, those whose irrigation was based on soil-less medium tensiometer readings produced lower total mean fruit weight then those whose irrigation was based on soil tensiometer readings. Number and weight, of defective fruit was lowest from plants grown in soil-less medium and whose irrigation was based on soil tensiometer readings, and greatest from soil-grown plants. Fruit cracking was reduced by increasing the irrigation frequency from 1 to 4 times daily. (Author's abstract)
W87-05884

INTRASPECIFIC VARIABILITY FOR DROUGHT RESISTANCE IN COWPEA,
Texas A and M Univ., College Station. Dept. of Horticultural Sciences.
For primary bibliographic entry see Field 2I.
W87-05885

RESPONSE OF APRICOT SEEDLING LINES TO WATERLOGGING,
Cairo Univ., Giza (Egypt). Dept. of Horticulture.
For primary bibliographic entry see Field 2I.
W87-05886

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

USDA PLANNING PROCESS FOR COLORADO RIVER BASIN SALINITY CONTROL,
Soil Conservation Service, Portland, OR.
J. D. Hedlund.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 63-77, 2 fig, 2 tab, 20 ref.

Descriptors: *Salinity, *Colorado River, *Management planning, *Saline soils, *Water quality control, Arid regions, State jurisdiction, Federal jurisdiction, Irrigation, Economic aspects, Saline water.

Today, 550,000 acres (222,750 ha) of irrigated land are going out of production each year due to salt buildup in arid land regions of the world. Cooperative planning by USDA with state and federal agencies has been underway since 1973 to reduce salinity problems in the Colorado River Basin. The most important beginning point in any planning effort is to accurately locate and define the magnitude of the problem. Salinity problems are not just a concern for those in the Colorado River Basin. Every state in the West has some high water table problems. Associated with high water table, in many cases, is a soil salinity problem which affects crop production on 10,300,000 irrigated acres (4,171,000 ha). Salt concentrations are increasing steadily in some of the nation's most productive soils. The rich San Joaquin Valley in California could eventually lose 2 million acres (810,000 ha) to salinization. Other areas with significant problems include the valleys of the Rio Grande and Pecos River, closed river systems in the Great Basin, the Arkansas River, tracts in Texas and Oklahoma, and tributaries of the Upper Missouri. Several ongoing programs (Wellton-Mohawk USDA, and Agricultural Conservation Program USDA) are providing technical and financial assistance to improve irrigation systems and management. Implementation plans will generally include the identification of financial and technical assistance available to the land owner or operator. USDA salinity programs are funded by a variety of authorities. USDA salinity control planning of needed on-farm irrigation improvements on individual units is essentially completed. Implementation is progressing on 3 of the 12 units. The USDA on-farm salinity control program is receiving positive reviews for cost-effectiveness, and the planning experience gained in this activity will be most helpful in formulating and justifying future salinity control programs. (See also W87-05171) (Lantz-PTT)
W87-05171

INTEGRATED CONTROL OF WATERHYACINTH (EICHHORNIA CRASSIPES) WITH A PATHOGEN, INSECTS, AND HERBICIDES,
Florida Univ., Gainesville. Dept. of Plant Pathology.
R. Charudattan.
Weed Science WEESA6, Vol. 34, Suppl. 1, p 26-30, 1986. 47 ref.

Descriptors: *Water hyacinth, *Biocontrol, *Weed control, *Pathogenic fungi, *Insects, *Herbicides, Florida, Plant pathology, Plant diseases.

The possibility of developing a practical integrated water hyacinth control system based on pathogens, arthropods and chemical herbicides was investigated. A fungal pathogen native to Florida and capable of inducing leaf spots, leaf necrosis and secondary root rot was discovered to be highly virulent to water hyacinth in greenhouse and field tests. The biocontrol effects of weevils, moths and mites have been tested and documented. Several chemical herbicides give good immediate control of water hyacinth, but have a negative effect on biocontrol agents when a large population of the plant is killed within a short period. The interaction between pathogenic fungi and arthropods was studied and results indicated that the combination yielded 99% control. Tests of 2,4-D and diquat combined with pathogenic fungi demonstrated that herbicides should not prevent pathogen infection by killing entire leaf tissues. Herbicides should also not interfere with host susceptibility or pathogen virulence. The level of fungal disease found in Florida has not been generally sufficient to control hyacinth and arthropods alone do not seem capable of producing complete weed control. Any chemical control program that drastically disrupts the buildup of arthropods is likely to affect the efficacy and reduce the long term benefits of water hyacinth insect biocontrol programs. Further work is needed to develop an integrated weed management system. (Michael-PTT)
W87-05263

GREAT LAKES DIVERSION AND CONSUMPTIVE USE: THE ISSUE IN PERSPECTIVE,
Center for the Great Lakes, Chicago, IL.
M. J. Donahue, A. A. Bixby, and D. Siebert.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 19-48, Winter 1986. 5 fig, 82 ref.

Descriptors: *Water law, *Legal aspects, *Great Lakes, *Consumptive use, *Diversion, *Water supply, *Water management, *Legal review, Water use, Regional planning, Routing, Legislation, Policy making, Public policy, Water policy, Planning, Project planning, Canals, Irrigation, Electric power production, Decision making.

An overview of and perspective on the issue of Great Lakes diversion and consumptive use is presented in support of The December 11-13, 1985 legal issues seminar sponsored by The Center for the Great Lakes. The paper is presented as a means to provide a common information base, focus attention on its importance and implications, introduce The Center's research, and present objectives of the seminar. The following issues are highlighted: (1) the emergence of the diversion and consumptive use issue as a leading regional policy consideration; (2) the characteristics and impacts of existing Great Lakes diversions and consumptive uses; (3) legislative and policy developments with implications for Great Lakes water management; and (4) the importance of a thorough assessment of the present legal framework for Great Lakes water quantity management and a determination of legal and policy options which might be pursued to strengthen that framework. (Author's abstract)
W87-05361

GREAT LAKES CHARTER: TOWARD A BASINWIDE STRATEGY FOR MANAGING THE GREAT LAKES,
Wisconsin Dept. of Administration, Madison.
For primary bibliographic entry see Field 6E.
W87-05362

INTER AND INTRASTATE USAGE OF GREAT LAKES WATERS: A LEGAL OVERVIEW,
Chicago-Kent Coll. of Law, IL.
For primary bibliographic entry see Field 6E.
W87-05363

OVERVIEW OF CANADIAN LAW AND POLICY GOVERNING GREAT LAKES WATER QUANTITY MANAGEMENT,
Canadian Environmental Law Research Foundation, Toronto (Ontario).

For primary bibliographic entry see Field 6E.
W87-05364

PUBLIC INTERNATIONAL LAW AND WATER QUANTITY MANAGEMENT IN A COMMON DRAINAGE BASIN: THE GREAT LAKES,
For primary bibliographic entry see Field 6E.
W87-05365

LAKE DIVERSION AT CHICAGO,
Illinois State Dept. of Transportation, Chicago. Div. of Water Resources.
For primary bibliographic entry see Field 6E.
W87-05366

MODEL STATE WATER ACT FOR GREAT LAKES MANAGEMENT: EXPLANATION AND TEXT,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 6E.
W87-05367

BINDING TIES, TYING BONDS: INTERNATIONAL OPTIONS FOR CONSTRAINTS ON GREAT LAKES DIVERSIONS,
For primary bibliographic entry see Field 6E.
W87-05368

WATER HARVESTING FOR RECLAIMING ALKALI SOILS,
Central Soil Salinity Research Inst., Karnal (India).
S. K. Kamra, V. V. D. Narayana, and K. V. G. K. Rao.
Agricultural Water Management AWMADF, Vol. 11, No. 2, p 127-135, April 1986. 4 fig, 3 tab, 17 ref.

Descriptors: *Water harvesting, *Rainfall-runoff relationships, *Runoff, *Storm runoff, *Land management, *Grasses, *Land reclamation, *Alkaline soils, Monsoons, Hydrogen ion concentration, Agriculture.

Alkali soils give a considerable amount of runoff during the monsoon and hence provide excellent opportunities for rainwater harvesting. A rainwater harvesting technique is presented in which alkali plots are divided into two compartments: the upper compartment is for rainwater harvesting and in the lower one alkali-tolerant grasses are grown. Results of a 4-year study show that a water harvesting compartment at least twice as large as the grassed compartment can provide sufficient rainwater for growing grasses. The pH value of the soil decreased from 10.6 to 9.0 in the 0-15 cm soil layer and in the lower layers to about 9.6. This proposed method of reclamation offers good possibilities for poor farmers, who cannot afford to install tubewells and purchase gypsum. This technique not only reclaims the land but also decreases the runoff from alkaline areas and thus reduces downstream problems. (Author's abstract)
W87-05449

COST COMPARISON BETWEEN CONVENTIONAL AND DETAINED DRAINAGE SYSTEMS,
UMA Engineering Ltd., Burnaby (British Columbia).
K.-B. Lee, and P. Ham.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 4, p 405-411, August 1986. 3 fig, 5 tab, 16 ref.

Descriptors: *Drainage, *Conventional drainage, *Detained drainage, *Runoff, *Cost analysis, *Comparison studies, *Drainage engineering, *Mathematical models, *Model studies, Costs, Cost-benefit analysis, Drainage effects, Drainage practices, Drainage water, Mathematical equations, Mathematical studies, Erosion, Flooding, Canada.

Three drainage basins in Surrey, B.C. (sizes ranging from 31 to 102 ha) were modelled on the basis of both the conventional design method and the design method incorporating detention. The cost for the overall drainage systems were then compared. The cost comparison indicates that for the three basins studied the cost advantage would be with the detained system, if downstream erosion and flooding are considered. If these downstream costs are not considered then the two systems are very similar in cost. (Author's abstract)
W87-05470

FISH SPECIES COMPOSITION IN NEW JERSEY SALT MARSHES: EFFECTS OF MARSH ALTERATIONS FOR MOSQUITO CONTROL,
Rutgers - The State Univ., New Brunswick, NJ. Zoology Graduate Program.
For primary bibliographic entry see Field 2L.
W87-05497

OPERATIONAL FLOOD WARNING SYSTEM,
G. A. Noonan.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 40, No. 5, p 437-453, October 1986. 6 fig, 4 ref.

Descriptors: *Flood forecasting, *Data processing, *Flood warning, *England, *Communication, *Hydrologic models, Rain gages, River forecasting, Monitoring, Compensation flows, Residual flows, Cost analysis.

The flood warning system of the North West Water Authority (England) is described including its operational procedures, equipment components, use of the regional communications scheme (RCS) in collection and dissemination of hydrometric data. The use of the RCS, with its capacity for rapid data transmission and its facility for running models, has improved very substantially the flood forecasting and flood warning capabilities of the Authority. Among the advantages noted compared the former system, which relied on manually interrogable rain and river level gauges, are: more frequent gathering of data, earlier recognition of gauge failures due to more frequent (15 min) interrogation interval, more rapid assessment of the extent and severity of an observed heavy rain, and ready availability of data for immediate use in other applications, such as monitoring residual and compensation flows. The RCS is expensive and probably could not be justified for flood forecasting alone. (Rochester-PTT)
W87-05562

PLAN FOR RESEARCH ON FLOODS AND THEIR MITIGATION IN THE UNITED STATES,
Illinois State Water Survey Div., Champaign.
S. A. Changnon Jr., R. J. Schicht, and R. G. Semonin.
Final Report to the National Science Foundation, SWS Contract Report 302, March 1983. Illinois State Water Survey Div., Champaign, Illinois. 226 p. Grant No. NSF-PAG-81-17027.

Descriptors: *Flood control, *Flood damage, *Flood plain management, *Flood plain zoning, *Floodproofing, Flood protection, Flood forecasting, Flood-control storage, Floodgates, Floodways, Flood profiles, Flood routing, Management planning, Coastal zone management, Public health.

From a national economic viewpoint, floods are the most destructive natural hazard in the United States. Recent assessments of flood problems and issues are used to compile a comprehensive assessment of the research needed relating to flooding and flood mitigation. The assessment of the research needs, largely done by experienced researchers on floods, was performed in the context of current and future policy issues affecting flood mitigation activities. Four new major national issues or trends are accounted for in this research assessment. (1) a shift in responsibilities from federal to local and state entities; (2) the policy of the National Flood Insurance Program; (3) the ongoing shift of emphasis from structural approaches to nonstrucutural approaches for flood mitigation such as flood plain management and zoning, coastal zone management, flood warning systems, evacuation and relocation, flood insurance, and land acquisition; (4) the recognition of the major new and developing national programs in emergency assistance. The major conclusion of the assessment is that much flood-related research must be interdisciplinary in nature. As a result 115 high priority research tasks in the fields of meteorology, hydrology and hydraulics, ecology, public health, economics, sociology, political science, and interdisciplinary fields are identified. All 115 tasks met the criteria for critical research, namely that the problem being addressed will probably be solved by further research, and that the cost of the research is justified by the benefits. (See also W87-05717 through W87-05726) (Geiger-PTT)
W87-05716

RESEARCH PROBLEMS IN HYDROLOGY AND HYDRAULICS,
For primary bibliographic entry see Field 2E.
W87-05718

ECOLOGICAL PERSPECTIVE ON FLOOD MITIGATION,
Kansas State Univ., Manhattan. Div. of Biology.
For primary bibliographic entry see Field 2E.
W87-05719

PUBLIC HEALTH RESEARCH NEEDS,
Epidemiology Research Center, Tampa, FL.
For primary bibliographic entry see Field 2E.
W87-05720

SOCIOLOGY RESEARCH NEEDS,
Denver Univ., CO. Dept. of Sociology.
For primary bibliographic entry see Field 6B.
W87-05722

LEGAL ASPECTS OF MITIGATING FLOOD DAMAGES,
American Bar Foundation, Chicago, IL.
For primary bibliographic entry see Field 6E.
W87-05724

INTERDISCIPLINARY RESEARCH,
Colorado Univ. at Boulder. Inst. of Behavioral Science.
For primary bibliographic entry see Field 2E.
W87-05725

GEOMORPHIC - HYDRAULIC SIMULATION OF CHANNEL EVOLUTION,
Water Engineering and Technology, Inc., Shreveport, LA.
For primary bibliographic entry see Field 2J.
W87-05794

PREDICTING CHANNEL ADJUSTMENT TO CHANNELIZATION,
Colorado State Univ., Fort Collins. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W87-05796

CHANNEL EVOLUTION IN MODIFIED TENNESSEE CHANNELS,
Geological Survey, Nashville, TN.
A. Simon, and C. R. Hupp.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-71 to 5-82, 5 fig, 3 tab, 11 ref.

Descriptors: *Channeling, *Tennessee, *Alluvial channels, *Sedimentation, *Channel morphology, Stream beds, Aggradation, Degradation, Erosion, Bank stabilization.

Channel dredging and straightening between 1959 and 1972 in West Tennessee caused a series of morphologic changes along modified reaches and tributaries. Degradation occurs for 10 to 15 years at sites upstream of the area of maximum disturbance (AMD) and can lower bed-level by as much as 6.1 meters. Aggradation downstream of the

AMD can reach 0.12 m/yr with the greatest rates near the mouth. Initially, degraded sites experience a secondary aggradation phase in response to excessive incisement and gradient reduction. The adjustment of channel width is characterized by six stages of bank-slope development: premodified, constructed, degradation, threshold, aggradation, and restablization. Downcutting and toe removal during the degradation stage causes bank failure by mass-wasting processes when the critical height of the bank material is reached (threshold stage). Top-bank widening continues through the aggradation stage as the slough line develops as an initial site of lower bank stability. The development of the bank profile is defined in terms of three dynamic surfaces: (1) vertical face (60 to 90 degrees), (2) upper bank (25 to 50 degrees), and (3) slough line (20 to 25 degrees). (See also W87-05791) (Lantz-PTT)
W87-05799

VEGETATION AND BANK-SLOPE DEVELOPMENT,
Geological Survey, Reston, VA.
C. R. Hupp, and A. Simon.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-83 to 5-92, 7 fig, 3 tab, 13 ref.

Descriptors: *Bank protection, *Slope protection, *Slope stabilization, *Bank erosion, *Vegetation, *Tennessee, Dredging, Sedimentation, Channel morphology, Erosion, Flood control.

Most streams in West Tennessee have been straightened and dredged for flood control. These modifications have initiated long-term changes in bed level and, in many cases, channel widening that occurs predominantly by mass wasting of banks. Dendroecologic and dendrogeomorphic analyses of riparian vegetation yield information on dates and rates of bank failure, bank-sediment accretion or erosion, and degree of bank-slope development. Widening rates up to 2.4 m/yr have been documented along highly unstable reaches. Similar analyses of buried tree stems on re-stabilizing banks indicate average accretion rates of 5 to 7 cm/yr. The presence of particular species indicate trends of increasing or decreasing stability. The most common woody plants on adjusting bank slopes include black willow, boxelder, river birch, and sycamore. The establishment of riparian vegetation promotes bank stability by ameliorating bank-erosional processes. Banks largely devoid of establishing woody vegetation are characteristic of the most unstable reaches. (See also W87-05791) (Author's abstract)
W87-05800

EVOLUTION OF TWO DREDGED CHANNELS IN OKLAHOMA,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
R. R. Schoof, P. B. Allen, and G. A. Gander.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-93 to 5-102, 6 fig, 2 tab, 7 ref.

Descriptors: *Dredging, *Channel erosion, *Oklahoma, *Channel improvement, *Sugar Creek, *Washita River, *Tonkawa Creek, Channeling, Sediment depositions, Vegetation, Bank Stabilization.

Eleven miles (18.3 km) of the Sugar Creek channel were dredged in 1967. Because the channel gradient, 0.0015 ft/ft, was too steep for the sandy alluvium, cross sectional area of the channel nearly doubled in two years. By 1969, maximum deposition on the lower end of Sugar Creek and in the Washita River was 6 ft, and the deposited volume was 650 acre-ft. By 1973, much of the deposition from Sugar Creek had been transported downstream, and the new bed was parallel to and approximately 2 ft higher than the bed of 1966. To reduce the erosion taking place in the dredged channel Kellner jacks, riprap, tree plantings and fencing were installed. After several years, most of the dredged channel had stabilized. However, bank and bed erosion still take place further upstream as a result of the dredging. Within the Sugar Creek valley, the water table has been lowered and flooding has vitually been eliminated. Thus much of the former Bermuda grass pasture has been replaced by higher value crops. The Tonkawa Creek channel was dredged for 3.6 mi (6 km) in 1973. This channel had 1.4 mi (2.3 km) of 0.0016 gradient and 2.2 mi (3.7 km) of 0.0007 gradient, and riprap was installed on the banks soon after dredging. Also, Tonkawa Creek has only 10-15% as much flow volume and peak as Sugar Creek. Thus, there have been no erosional problems within the Tonkawa Creek channel. (See also W87-05791) (Author's abstract)
W87-05801

CHANNEL ADJUSTMENTS OF THE LOWER COLORADO RIVER,
Bureau of Reclamation, Boulder City, NV.
D. P. McCleary.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-103 to 5-112, 6 fig, 1 tab, 8 ref.

Descriptors: *Channel morphology, *Colorado River, *Channel flow, *Sedimentation, *Lake Powell, *Glen Canyon Dam, Channel improvement, Bank stabilization, Bank erosion, Channeling, Alluvial rivers.

During the high flows of 1983-84, stabilized reaches of the lower Colorado River experienced channel degradation, while lateral erosion of the bankline characterized unstabilized sections. These effects are in keeping with regime theories of alluvial rivers which relate variables such as discharge, depth, and sediment properties. Major channelization projects are planned for the Parker and Limitrophe Divisions, probably the two most unstable reaches of the river. Design analysis must consider impacts of the recent high flows as related to the channel configurations favored by the river. With the filling of Lake Powell behind Glen Canyon Dam, a buffer for absorbing large Colorado River Basin runoffs no longer exists. Thus, higher flows than those of the past 15 years may be expected in the lower Colorado, requiring a period of further adjustments of the river channel. (See also W87-05791) (Lantz-PTT)
W87-05802

ALLUVIAL TRENDS: NOTCHED RIVER CONTROL STRUCTURES,
Corps of Engineers, Omaha, NE.
K. A. Myers.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II. 1986. p 5-113 to 5-122, 1 fig, 2 tab, 9 ref.

Descriptors: *Alluvial rivers, *Notches, *River flow, *Flow control, *Missouri River, Dikes, Bank stabilization, Environmental effects, Channeling, Sediment deposition, Sedimentation.

A program to retain the floodway conveyance along the Missouri River through the use of notched river control structures was initiated in 1975. The purpose of the program, which included all of the Bank Stabilization and Navigation Project from Sioux City, Iowa, to the Mouth, was to alter depositional patterns behind river control structures by increasing the flow conveyance of the river affecting the navigation channel design criteria. Within the dike systems, however, aggradation developed naturally in the shallow water areas, causing a reduction in the total water surface area. The notch program was intended to maintain or renew shallow water areas by providing a means for water to pass through and between rock structures, thus preventing sediment deposition downstream and landward of the structures. Over 1300 notches have been constructed since 1975 by excavating a portion of existing stone-fill structures or omitting repairs on small portions of damaged structures. Habitat enhancement evolved as an indirect benefit of the notches, and the program was expanded in 1982 to incorporate underwater reefs in conjunction with the nothces. The underwater reef concept was included since such reefs not only have an impact on sediment deposition, but also afford fish protection, food, security, and a reference point by reducing light and providing a discontinuous substrate. Investigations have shown that the notch program may not substantially reverse the trend of reduced water surface area along a channelized river, but the program may be instrumental in minimizing further reduction of open water areas by preserving existing pools, chutes, islands, and sandbar areas found along the Missouri River. (See also W87-05791) (Author's abstract)
W87-05803

DEVELOPMENT AND APPLICATION OF A SEDIMENTATION MODELING SYSTEM,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2J.
W87-05817

ALGORITHM FOR ROUTING UNSTEADY FLOWS IN URBAN DRAINAGE NETWORKS,
Gutteridge, Haskins and Davey Pty Ltd., Sydney (Australia).
For primary bibliographic entry see Field 2E.
W87-05860

4B. Groundwater Management

SALINITY CONTROL PROBLEMS ASSOCIATED WITH IRRIGATION IN SOUTH-WEST NEW SOUTH WALES, AUSTRALIA,
Water Resources Commission of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 5G.
W87-05189

ISSUES IN GROUNDWATER MANAGEMENT.
Texas Univ. at Austin. Center for Research in Water Resources.
Water Resources Symposium Number Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. Edited by Ernest T. Smerdon and Wayne R. Jordan. 498 p.

Descriptors: *Groundwater management, *Texas, *Management planning, Groundwater quality, Legal aspects, Groundwater pollution, Water pollution prevention, Salinity, Conferences, Aquifers, Ogallala Aquifer, Edwards Aquifer, Coastal Aquifer, Saline water, Economic aspects.

This publication contains the proceedings of a symposium entitled 'Groundwater-Crisis or Opportunity,' which was held in San Antonio October 29-31, 1984. It is one of several efforts related to water resources undertaken cooperatively in recent years by The University of Texas at Austin and the Texas A & M University System. Current problems associated with groundwater management include legal issues, problems of potential pollution of aquifers, problems of salinity in groundwater from natural causes or from saltwater encroachment, and many others. The different aquifers in Texas each pose a unique set of challenges. Three distinctly different aquifers were chosen for analysis-the Ogallala, the Edwards, and the Coastal Aquifer. The papers presented here cover the broad range of problems associated with effective management of groundwater. These include analyses of the hydrological characteristics of the aquifers, the legal and institutional issues, the water pollution hazard and how to monitor and control it, and the economic value of groundwater, both in the past and in the future. It is now widely recognized that the solution to future water problems in Texas will require more effective management of the water resources than in the past. New supplies to meet future needs are not without limit; therefore, the solution to the problem will have to come from better water conservation as well as by providing new supplies. In some cases, conservation and reuse may be the only feasible answer. To accomplish what is needed will require the best efforts of all Texans. Good research programs will be required to discover ways to improve on what

has been done in the past. (See also W87-05220 thru W87-05249) (Lantz-PTT)
W87-05219

GROUNDWATER--THE CHANGING PROBLEM IN TEXAS,
Texas Dept. of Water Resources, Austin.
C. E. Nemir.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 3-9.

Descriptors: *Texas, *Groundwater management, *Groundwater potential, *Groundwater quality, Legislation, Water quality control, Saline water intrusion, Groundwater pollution, Water pollution prevention, Water use, Aquifers, Brine, Groundwater irrigation, Water resources development.

Texas holds resources for substantial supplies of groundwater. In all but a few areas in the state, groundwater of good quality can be obtained in sufficient quantities for domestic purposes. In many areas, groundwater-producing formations yield large quantities of water to wells. Such large capacity wells are capable of supplying water for municipalities, industries, and irrigated agriculture. The ability to develop groundwater has led to significant economic development in the state. The availability of underground water has contributed greatly to the growth of sveral major cities, as well as some principal industries, and agricultural production in many areas of the state has been greatly enhanced through groundwater development. As the state continued to grow, so did the need for water. This need was met, in large part, by developing groundwater. Groundwater, most of which as used for irrigation, supplied 74% of all water used in Texas in 1960. In the 1950s, increased concern began to be expressed over the possible contamination of the state's aquifers, especially by man's activities. Of principal concern was salt water contamination, particularly from brine produced with oil and gas that was being discharged into unlined surface pits. Another groundwater concern was the encroachment of naturally occurring saline water within aquifers due to water level declines. In 1958, it was generally believed that reasonably thorough groundwater information had been compiled for about one-tenth of the state, and that practically no information other than that on the general geology of an area was available for about one-half the state. At about this time, Texas began to expand its groundwater studies program. Probably the biggest change is the widespread realization that groundwater resources must be protected from contamination. Passage of various laws (Federal Clean Water Act, Resource Conservation and Recovery Act, and Safe Drinking Water Act) have helped to ensure the quality and protection of groundwater for future generations. (See also W87-05219) (Lantz-PTT)
W87-05220

CONNECTIONS BETWEEN GROUNDWATER AND ECONOMIC GROWTH,
Texas Univ. at Austin. Graduate School of Business.
V. L. Arnold.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 11-19, 2 fig, 9 ref.

Descriptors: *Groundwater management, *Economic aspects, *Texas, *Cost-benefit analysis, Groundwater irrigation, Pumping, Policy making, Mathematical analysis, Economic analysis, Model studies, Economic efficiency.

Groundwater in Texas is economically scarce, but not so physically limited as to be a serious threat to growth of the economy. There may be, however, curtailment of primary product production because of increasing groundwater economic scarcity (revealed as increasing pumping costs from groundwater aquifers). The curtailment will probably be most severe in irrigated agriculture. The economic effect may be dramatic in certain regions of the state, but should have a modest impactt on the state's overall economy. The groundwater problem, then, is more a problem of policy choices about the institutional environment within which groundwater is managed, than it is with physical scarcity. Groundwater has been managed as a common property resource, and that has influenced the type of economic growth that has occurred. There is economic theory relating to common property resources. Groundwater is viewed in the context of that theory and an alternative institutional environment is proposed for the management of that resources. A common property resource in a competitive market is characterized by its ability to be utilized simultaneously by more than one individual or economic unit. Natural resources often classified under this general term are air, groundwater, public grazing land, petroleum deposits, and marine resources. These resources have no formal property structure; thus no user has exclusive rights to the resources nor can one prevent others from sharing in its use. This paper begins with a short review of the literature at the endogenous variable stage, traces the development of common property economic analysis through the sustainable-yield concept, and discusses the effects of unrestricted user entry and the physical-equilibrium model. (See also W87-05219) (Lantz-PTT)
W87-05221

OGALLALA AQUIFER - FACTS AND FALLACIES,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 2F.
W87-05222

ENHANCED RECOVERY OF GROUNDWATER FROM THE UNSATURATED ZONE: THE OGALLALA CASE,
Texas Agricultural Experiment Station, College Station.
D. L. Reddell, A. W. Wyatt, and B. J. Claborn.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 33-52, 6 fig, 3 tab, 8 ref.

Descriptors: *Groundwater management, *Water supply development, *Aeration zone, *Ogallala Aquifer, Model studies, Groundwater potential, Permeability, Unconsolidated aquifers, Aquifers, Saturation, Air-water interfaces.

An effort to model the effects of air injection into the unsaturated zone of an aquifer is discussed. However, insufficient data on relative permeability versus saturation for the air and water phases in unconsolidated groundwater aquifers were available. Without good data to describe these relationships, the model can give strange results. The main reasons for this are: (1) relative permeability curves for both water and air phases are needed not only for the drainage cycle, but for the wetting cycle as well. The effects of hysteresis on relative permeabilities in groundwater hydrology remain a practically untouched area; (2) based on previous findings, it can be assumed that an understanding of the basic relationship between saturation history and the corresponding effects on relative permeabilities, needs to be estabiiahed; (3) data sets of relative permeability versus saturation, and capillary pressure versus saturation for both wetting and drainage cycles are needed for all layers involved in a model, and in all directions, particularly for confining layers; and, (4) a better understanding of the boundary conditions of the system is considered essential. More research is needed on the basic physics of simultaneous air-water movement and this should be the thrust of future efforts. Since groundwater aquifer data were unavailable, petroleum reservoir data were used to simulate air injection into a water-air reservoir with known and fully described properties. These data show that air injection to recover water from the unsaturated zone merits further study. (See also W87-05219) (Lantz-PTT)
W87-05223

POTENTIAL FOR UTILIZATION OF BRACKISH GROUNDWATER,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 3C.
W87-05227

SOME CHALLENGES AND OPPORTUNITIES IN GROUNDWATER MANAGEMENT,
J. O. Williams.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 127-134, 2 ref.

Descriptors: *Groundwater management, *Water management, *Water resources development, Groundwater availability, Water supply development, Water supply, Aquifers, Groundwater.

Good groundwater resources management must be based on a comprehensive understanding of the physical and economic systems involved. To many, management means simply the reduction of groundwater extractions to bring total pumpage into balance with some value of the so-called 'safe yield'. Groundwater resources management, is the protection, development, and use of groundwater resources of the particular aquifer system concerned - generally in conjunction with available surface water resources, and possibly including reclaimed water - in the manner most effective in meeting evolving water resource development and water use objectives. Since the boundaries of the geologic formations which serve as aquifers are not related to state boundaries, the physical problems are the same for interstate or intrastate aquifers. The same problems that develop when two neighboring communities share a groundwater supply will develop whether or not the communities live in the same state. Some observations on management efforts to this point seem evident: (1) In the United States, the only governmental authorities which operate without restraint across state lines are the federal government, and those agencies created by interstate compact; (2) Without the active concurrence and support of the water users involved, and with full recognition on their part of the problems to be solved and the benefits gained by submitting to a management strategy, it is unlikely that imposition of management would be politically or practically feasible; (3) Generally, management can be most effectively accomplished at the local or regional governmental level, operating within a framework of powers and duties established by state statutes; (4) Current laws, both statute and case, concerning water rights impede, and, in some cases, block effective management. (See also W87-05219) (Lantz-PTT)
W87-05228

EMERGING LEGAL CHALLENGES FOR GROUNDWATER MANAGEMENT,
Texas Tech Univ., Lubbock. School of Law.
For primary bibliographic entry see Field 6E.
W87-05229

LESSONS FROM THE REST OF THE WEST: A SURVEY OF GROUNDWATER MANAGEMENT IN CALIFORNIA, COLORADO, NEW MEXICO, AND NEBRASKA,
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 165-173, 3 ref.

Descriptors: *Groundwater management, *Legal aspects, *Water scarcity, *California, *Colorado, *New Mexico, *Nebraska, Groundwater pollution, Water resources development, Pumping.

Groundwater has characteristics that make state intervention in its use necessary. These are: (1) relative scarcity, (2) absolute scarcity, and (3) contamination. This paper focuses on the first two characteristics. Relative scarcity occurs when

pumpers in a basin cannot obtain required amounts at pre-existing pumping levels. Unlike surface streams, groundwater basins may not be sucked dry in any given year. Rather, any shortage that occurs is not to an absolute amount of water but to an amount of water at a given static pressure level. Economists advise that in order to promote the efficient allocation of resources, property rights must be well defined, enforced, and transferable. Well-defined rights are basically rights that make clear, exclusive assignments to one entity. The other two attributes, enforceability and transferability, follow from an exclusive assignment. Once an individual sphere of control is delineated, it is possible to determine what is an interference and to protect the right holder against it. Clear and enforceable rights are obviously saleable items, if the resource has value, and thus the right is transferable. With respect to groundwater, the sticky point is the first characteristic of property right. It is difficult to assign exclusive rights to a resource when, for physical reasons, one claimant's consumption inevitably interferes with another claimant's legitimate consumption. A survey of groundwater law and administration in California, Colorado, New Mexico, and Nebraska shows that no state has developed a perfect solution. However, each of these states has developed a solution to the twin problems of pressure declines and mining. Groundwater control is rooted in the needs of each state, and as a result, one state's institutions are not readily transferable to another state; but, taken together, the experience of the states surveyed here illustrate some realistic approaches to groundwater conservation. (See also W87-05219) (Lantz-PTT)
W87-05230

DEVELOPMENT OF THE NEW ARIZONA GROUNDWATER CODE,
Arizona Dept. of Water Resources, Phoenix.
For primary bibliographic entry see Field 6E.
W87-05231

CONJUNCTIVE MANAGEMENT OF GROUND AND SURFACE WATER NEW MEXICO CASE LAW AND POLICY ISSUES,
New Mexico Univ., Albuquerque. School of Law.
C. T. DuMars.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 197-217, 58 ref.

Descriptors: *Groundwater management, *Surface water, *New Mexico, *Legal aspects, *Public policy, Surface-groundwater relations, Groundwater storage, Management planning, Water use, Groundwater mining, Pumping.

The difficult problem of conjunctive management of ground and surface water is explored. Part one of the paper explains in laymen's terms the hydrological connection that can exist between streams and groundwater in storage near the stream. Part two examines the New Mexico case law and describes the regulatory scheme reflected in two leading cases: City of Albuquerque v. Reynolds and Templeton v. Pecos Valley Artesion Conservancy District. Part three discusses briefly the way other states address the conjunctive management problem. Part four discusses some of the problems associated with the doctrines developed in New Mexico and the problem as it exists throughout the west. New Mexico has recognized the interconnection between ground and surface water. In some areas, the state engineer has worked to coordinate the withdrawal of the groundwater with the impact of the pumping on the surface water. New Mexico courts have also addressed the inequities of the situation where surface water has been depleted due to groundwater pumping by allowing supplemental wells by surface water users. The management problem is intricate and the exact impact of the pumping from wells is not clear. In the mind of the administrator and the pumper, it is all too often a circumstance where a present action that will not bear its bitter fruit until far into the future is allowed. By then, the present water user will be retired and the administrator likewise, but the new generations of water users in some cases may be coping with a problem of environmental and economic consequence of a magnitude no one had imagined. (See also W87-05219) (Lantz-PTT)
W87-05232

LEGISLATIVE PERSPECTIVE ON TEXAS GROUNDWATER: CONSTRAINTS AND POSSIBILITIES,
Texas Office of the Lieutenant Governor, Austin.
S. Stagner.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 219-224.

Descriptors: *Groundwater management, *Legislation, *Texas, *Aquifers, Public policy, Cost analysis, State jurisdiction, Water law, Regional planning.

The first real constraint in groundwater policy is the diversity of aquifers in Texas. Texas has no relatively homogeneous natural systems susceptible to homogeneous management approaches, as do many states. The second constraint to effective management is an excessive allegiance to the principle of complete control by local districts in the fact of a good deal of evidence that there are some problems with this approach. The constraint of knowledge is the third difficulty; the lack of knowledge of policy options, and of the specific costs and benefits of certain actions in certain regions. Much of the discussion about groundwater management in Texas has been fairly general and focused on problems. There has been little specific discussion of how to implement statewide goals. One option that offers some possibilities is the idea of a state funded and guided regional planning process. Another possibility is for legislative action with respect to changes in Chapter 52 of the Water Code - the section governing the formation and operation of underground water conservation districts. The issue of state oversight over districts is another thorny problem. There have been proposals to give the Texas Department of Water Resources oversight authority over the rule-making process of local districts. The ultimate question is whether or not groundwter is a statewide or purely local issue. An increasing number of voices are arguing that the economic implications of regional groundwater pumpage extend beyond regional boundaries, and that Texans are all, to an extent, in this together. (See also W87-05219) (Lantz-PTT)
W87-05233

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT: A REPORT ON ITS CREATION, POWERS, LIMITATIONS OF POWERS, AND PROGRESS,
Butler and Binion, Houston, TX.
For primary bibliographic entry see Field 6E.
W87-05234

EDWARDS UNDERGROUND WATER DISTRICT,
Fulbright and Jaworski, San Antonio, TX.
For primary bibliographic entry see Field 6E.
W87-05235

ADDITIONAL LEGISLATIVE POWERS NEEDED BY UNDERGROUND WATER CONSERVATION DISTRICTS IN THE OGALLALA AREA,
McCleskey, Harringer, Brazill and Graf, Lubbock, TX.
For primary bibliographic entry see Field 6E.
W87-05236

LARGE-SCALE OPTIMIZATION MODELS FOR GROUNDWATER MANAGEMENT,
Texas Univ. at Austin. Dept. of Civil Engineering.
L. W. Mays, N. Wanakule, and L. Lasdon.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 309-329, 7 fig, 15 ref.

Descriptors: *Groundwater management, *Optimization, *Model studies, *Mathematical models, Simulation analysis, Finite difference methods, Groundwater movement, Flow, Computer models, Mathematical studies, Mathematical analysis, GWMAN, GWSIM, GRG2.

A general groundwater management model of the simulation-optimization type. Named GWMAN, makes use of two previously developed computer programs, GRG2 and GWSIM. GRG2 is a nonlinear programming code employing the generalized reduced gradient method. GWSIM is a simulation model that solves the nonsteady heterogeneous anisotropic groundwater flow equations which can accomodate composite aquifer conditions as well. The solution to the finite difference equations in GWSIM is obtained through the alternating direction implicit procedure. GWMAN views the groundwater management problem as an optimal control problem where the pumpage (or recharge) and the piezometric heads correspond to controls and states, respectively. The generalized reduced gradient is the basic algorithm for the solution procedure where the state and control variables are regarded as basic and nonbasic variables. To avoid the degeneracy problem, the system state boundary or the head bound constraints are incorporated into the objective function through the Augmented Langrangian method. In consequence, the original problem is transformed into an optimization program called RGAL (Reduced Gradient with Augmented Lagrangian), which is solved in the control domain by GRG2. Once the controls are known, GWSIM is applied whenever the state of the system needs to be evaluated. In the final model, the number of decision variables is the number of control variables and only the general constraints are considered. This makes GWMAN an alternative method of solving the groundwater management problem which is superior to the unit response matrix approach. (See also W87-05219) (Lantz-PTT)
W87-05240

DIGITAL TERRAIN MODELING OF GEOLOGIC DATA FOR A GROUND-WATER MONITORING PROGRAM,
Alabama Power Co., Birmingham.
For primary bibliographic entry see Field 7C.
W87-05376

WICKING BAY MUD,
Brian, Kangas, Foulk and Associates, Redwood City, CA.
For primary bibliographic entry see Field 8D.
W87-05385

AVOIDING OCHRE DEPOSITS IN SOIL DRAINAGE PIPES,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
A. Abeliovich.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 327-334, December 1985. 3 fig, 2 tab, 15 ref.

Descriptors: *Pipes, *Pipe flow, *Iron ochre, *Drainage practices, *Drains, *Bacteria, *Subsurface drains, *Groundwater level, *Soil types, Dead Sea, Anaerobic conditions, Microaerophilic conditions, Field tests, Siphons.

Leptothrix sp. was identified as the causitive agent producing ochre problems in an intensively irrigated area near the Dead Sea. By creating anaerobic or microaerobic conditions in experimental drainpipes in the field with siphons installed at the outlet or in intermediate manhole, ochre production was avoided. Similarly, clogged drainpipes were cleaned within weeks by raising the groundwater level around the pipe. (Author's abstract)
W87-05437

INTERACTIVE COMPUTER GRAPHICS-BASED MULTIOBJECTIVE DECISION-

MAKING FOR REGIONAL GROUNDWATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6A.
W87-05447

OPTIMIZING THE RAPID EVOLUTION OF TARGET GROUNDWATER POTENTIOMETRIC SURFACES,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
R. C. Peralta, and K. G. Kowalski.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 940-947, July-August 1986. 5 fig, 25 ref.

Descriptors: *Groundwater management, *Groundwater potential, *Aquifers, *Optimization, *Recharge, *Discharge, *Water table rise, Irrigation, Agriculture, Hydraulic gradient, Drought, Pumping, Simulation.

The long-term availability of adequate groundwater for sustainable irrigated agricultural production can be assured by causing the evolution and maintenance of an appropriate potentiometric (piezometric) surface in utilized aquifers. By providing adequate saturated thickness and hydraulic gradients and heads, such a surface affords some protection from the effects of drought, economic hardship, and environmental or legal complications. Procedures for determining desirable or optimal regional steady-state groundwater potentiometric surfaces have been reported by several researchers. An existing potentiometric surface can be forced to evolve into a desirable 'target' surface if it is subjected through time to the proper combination of recharges and discharges. Depending on the difference between initial and target surfaces, steady pumping strategies may require extended periods to complete the evolutionary process. The evolutionary period may be significantly shortened by using a time-varying pumping strategy. Such a strategy may be calculated by combining goal programming and simulation. The presented technique maximizes attainment of target potentiometric surface elevations within a predetermined planning period. It is a valuable tool for a management agency that is seeking to determine how to most rapidly achieve desireable groundwater conditions in either an undeveloped region or a region that has an existing pattern of groundwater pumping. (Author's abstract)
W87-05520

SIMULATED WATER TABLE MANAGEMENT BY CONTROLLED-DRAINAGE BASED ON RAINFALL FORECASTS,
Agricultural Research Service, Baton Rouge, LA. Soil and Water Pollution Research Unit.
For primary bibliographic entry see Field 2F.
W87-05525

MAINTAINING TARGET GROUNDWATER LEVELS USING GOAL-PROGRAMMING: LINEAR AND QUADRATIC METHODS,
Maryland Agricultural Water Quality Cost-Share Program, Annapolis.
A. Yazdanian, and R. C. Peralta.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 995-1004, July-August 1986. 9 fig, 3 tab, 17 ref.

Descriptors: *Groundwater level, *Groundwater management, *Model studies, *Mathematical models, *Groundwater recharge, Groundwater movement, Kriging, Aquifers, Groundwater, Equations, Grand Prairie, Arkansas.

Sustained-yield groundwater management strategies can be designed to closely maintain preassigned 'target' levels. Quadratic and linear goal-programming objective functions are used in two distinct models which minimize the sum of differences between 'target' and regionally optimized sets of groundwater levels. Constraints and bounds imposed on extractions, recharge and heads in each model assure that developed strategies are physically feasible and sustainable. The linear model is computationally more time-efficient, but numerical difficulties due to equality constraints are encountered when it is applied to large groundwater systems. The quadratic model requires less computer storage and is applied to the Grand Prairie of Arkansas as an example. (Author's abstract)
W87-05526

IN SITU TREATMENT OF GROUND WATER BY THE SUBTERRA METHOD,
For primary bibliographic entry see Field 5G.
W87-05579

PREDICTING THE OCCURRENCE OF 228RA IN GROUND WATER,
Research Planning Inst., Inc., Columbia, SC.
For primary bibliographic entry see Field 5B.
W87-05584

AQUEOUS GEOCHEMISTRY AND DIAGENESIS IN THE EASTERN SNAKE RIVER PLAIN AQUIFER SYSTEM, IDAHO,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W87-05600

WATER REGIME OF A MOLE DRAINAGE EXPERIMENT ON A HEAVY CLAY SOIL OF THE SOLOGNE AREA (FRANCE),
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
For primary bibliographic entry see Field 2G.
W87-05690

SIMULATION OF THE HYDRAULIC BEHAVIOUR OF A PLOT OF DRAINED AND TILLED MARSHLAND,
For primary bibliographic entry see Field 2G.
W87-05692

INFLUENCE OF DRAIN DEPTH ON THE RATE OF SOIL RECLAMATION IN IRRIGATED AREAS OF SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Drainage Branch.
G. D. Buckland, D. B. Harker, and T. G. Sommerfeldt.
Canadian Journal of Soil Sciences CJSSAR, Vol. 66, No. 3, p 531-535, August 1986. 2 fig, 1 tab, 10 ref.

Descriptors: *Subsurface drainage, *Land reclamation, *Saline soils, *Leaching, *Drainage practices, Irrigation, Soil types, Alberta.

In semi-arid to arid irrigated regions subsurface drainage is practiced to control the soil salinity which is associated with shallow water table conditions. Salinity control and reclamation in Alberta can be achieved with subsurface drains installed at depths ranging from 0.8 to 1.8 m. This study assesses the effect of drain depth on the rate of soil reclamation of two saline-sodic soils over 2 years of leaching. Subsurface drains were installed at 0.76, 1.22, and 1.68 m. At one site, after 2 yr of leaching, average salinity levels in the 0- to 2.0 m soil depth were reduced to 91, 88, and 74% of original levels with drain depths of 0.76, 1.22, and 1.68 m, respectively. At the other site, where less water was applied, respective salinity levels were 114, 86, and 99% of original levels. Resalinization and resodification of the surface 0.2 m of soil occurred at both sites in the second year, which was a drought year, and were most pronounced with a drain depth of 0.76 m. Relative reductions in salinity, and efficiency of leaching, were lowest for the 0.76 m depth drains at both sites. (Authors' abstract)
W87-05880

EFFECTS OF IRRIGATION FREQUENCY AND SCHEDULING ON FRUIT PRODUCTION AND RADIAL FRUIT CRACKING IN GREENHOUSE TOMATOES IN SOIL BEDS AND IN A SOIL-LESS MEDIUM IN BAGS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W87-05884

EVAPOTRANSPIRATION AND GROUNDWATER RECHARGE - A CASE STUDY FOR DIFFERENT CLIMATE, CROP PATTERNS, SOIL PORPERTIES AND GROUNDWATER DEPTH CONDITIONS,
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Oekologie.
For primary bibliographic entry see Field 2D.
W87-05887

4C. Effects On Water Of Man's Non-Water Activities

ANALYSIS OF SALT YIELDS ASSOCIATED WITH THE CONSTRUCTION AND OPERATION OF PARIETTE DRAW WILDLIFE AREA, UTAH,
Bureau of Land Management, Lakewood, CO. Denver Service Center.
For primary bibliographic entry see Field 5B.
W87-05216

SECONDARY SALINIZATION OF WATER RESOURCES IN SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 5B.
W87-05218

IMPACTS OF LIGNITE MINING ON GROUNDWATER IN TEXAS,
Texas Univ. at Austin. Bureau of Economic Geology.
G. E. Fogg, and R. J. Charbeneau.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 361-377, 5 fig, 3 tab, 22 ref.

Descriptors: *Lignite, *Mining, *Groundwater pollution, *Texas, *Water pollution effects, Aquifers, Groundwater quality, Permeability, Mine wastes, Research priorities.

Lignite mining in Texas is a groundwater issue because most of the mining occurs within a major aquifer system, the Wilcox Group. Extraction of the lignite by open-pit mining or in situ gasification can potentially affect quantity and quality of groundwater resources. This paper discusses the seriousness of past impacts and the potential for future impacts. There appears to be little chance that existing mines will seriously impact groundwater quality or quantity in Texas. The impacts will be mitigated by (1) the low-permeability, interchannel sediments that surround most of the lignites; (2) the typically shallow depth of mining (150 ft, or 46 m), which minimizes dewatering/depressurization needs and the chance of intersecting the more permeable Wilcox Channel sands; and (3) processes of geochemical attenuation (dispersion and mixing will tend to dilute any groundwater contaminants introduced by mining). Moreover, existing data suggest that the mine spoil does not generate groundwater that is much different in chemical composition than the premining groundwater. The most serious issues of lignite mining in Texas pertain to future trends in the areal density and depth of mining. Although a single shallow mine probably will not pose a serious threat to groundwater resources, the collective impact of several mines closely spaced could be far more significant. Similarly, as mines extend deeper, depletion of groundwater resources and the chances of disturbing the more permeable channel sands will increase. These are clearly regional issues, and they bear heavily on the future of the important groundwater resources of the Wilcox Group, a major aquifer system. (See also W87-05219) (Lantz-PTT)
W87-05243

GROUNDWATER IMPACTS OF SOLUTION MINING,
Texas Dept. of Water Resources, Austin.
J. L. Peters, and R. J. Charbeneau.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 379-386, 2 ref.

Descriptors: *Groundwater pollution, *Solution mining, *Liquification, *Texas, *Groundwater restoration, Uranium, Sodium sulfate, Sulfur, Aquifers, Natural restoration, Groundwater sweep, Groundwater recirculation, Chemical flush.

In Texas solution mining is used in the mining of brines, sodium sulfate, sulfur, and uranium. The advantages stem from the nondisturbing nature of the method that leaves the surface and subsurface physically intact. This is advantageous not only during mining, but also upon its termination when there is a minimum restoration requirement of the terrain. However, in some cases these advantages may be somewhat offset when a considerable chemical restoration of a host aquifer is required. When a company completes its mining operations it is required to notify the Texas Department of Water Resources, and to commence to restore the groundwater quality of the affected area of the aquifer. The restoration must be to quality levels consistent with the premining (baseline) groundwater quality. Until restoration is accomplished, semiannual restoration progress reports are required. Restoration monitoring must continue until three consecutive sets of groundwater samples indicate that restoration is complete. At this time all wells must be plugged. There are several ways in which restoration can be pursued. The simplest approach is termed natural restoration. In this method, there is an initial production of a few pore volumes of the most contaminated water from the mine zone. A second method of restoration is groundwater sweep. Here, injection activites are curtailed while production of the aqufier is extended until the mined area is 'washed out' by the surrounding groundwater. A third method of restoration is groundwater recirculation. Here, restoration is achieved by continued pumping through the same injection and production wells used in the mining operations, except that the direction of induced flow may change and the groundwater is reinjected without being reconstituted with the leaching solution. The final method, chemical flush, is a modification of the recirculation method where the water being treated at the surface is fortified with chemicals that enhance the restoration process. Regulatory issues concerning the impacts of solution mining are also discussed. (See also W87-05219) (Lantz-PTT)
W87-05244

EFFECTS OF LAND USE ON THE HYDROLOGY OF SMALL BASINS IN HESSEN (FEDERAL REPUBLIC OF GERMANY),
Giessen Univ. (Germany, F.R.). Inst. fuer Mikrobiologie und Landeskultur.
For primary bibliographic entry see Field 2A.
W87-05738

SEDIMENT YIELD AND RUNOFF AFTER TIMBER HARVEST,
Bureau of Land Management, Missoula, MT.
For primary bibliographic entry see Field 2J.
W87-05763

PHOTOGRAMMETRIC ANALYSIS OF CHANNEL ADJUSTMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2J.
W87-05793

CHANNEL WIDTH ADJUSTMENT IN STRAIGHT ALLUVIAL STREAMS,
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W87-05795

EVALUATION OF A ROAD SEDIMENT MODEL,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W87-05825

SEDIMENT/FISH MODELING IN THE SOUTH FORK SALMON RIVER,
Fayette National Forest, McCall, ID.
P. N. Jahn, and D. C. Burns.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 377-386, 8 fig, 12 ref.

Descriptors: *Model studies, *South Fork Salmon River, *Sediment transport, *Fish, Environmental effects, Logging, Mining, Roads, Sediment yield, Sedimentation, Aquatic habitats.

Idaho's South Fork Salmon River has been controversial since the mid-1960's when a combination of factors including intensive logging, mining, roading activities, wildfire, and an unusually large spring runoff severely reduced the spawning and rearing habitat of anadromous fish and other salmonids utilizing the drainage. Following the events of the mid-1960's, major efforts were undertaken by several state and federal agencies, including the USDA-Forest Service, to mitigate the disturbances causing sedimentation and to monitor the recovery of the river system. The recent development of sediment production and fish response models by Regions 1 and 4 of the Forest Service affords the opportunity to quantitatively evaluate the history of the drainage comparing sediment production potentials to monitored changes in fish habitat. Today, accelerated sediment potentials are well below the levels of the 1950's and 60's and have stabilized. Fish habitats have recovered significantly from an estimated low of 20% of natural potential in 1966. Understanding the relationships between 40 yr of past management and concurrent changes in fish habitat within the drainage helps planners evaluate probable impacts and monitoring needs associated with future long-term management alternatives. (See also W87-05791) (Author's abstract)
W87-05830

ALGORITHM FOR ROUTING UNSTEADY FLOWS IN URBAN DRAINAGE NETWORKS,
Gutteridge, Haskins and Davey Pty Ltd., Sydney (Australia).
For primary bibliographic entry see Field 2E.
W87-05860

EFFECTS OF FOREST CLEARCUTTING IN NEW ENGLAND ON STREAM MACROINVERTEBRATES AND PERIPHYTON,
Northeastern Forest Experiment Station, Durham, NH.
D. S. Noel, C. W. Martin, and C. A. Federer.
Environmental Management EMNGDC, Vol. 10, No. 5, p 661-670, September 1986. 2 fig, 7 tab, 31 ref. DOI Project A-031-NH.

Descriptors: *LMacroinvertebrates, *Periphyton, *Stream biota, *Stream degradation, *Stream pollution, *Logging, *Clearcutting, Watershed management, Aquatic insects, Algae, Chlorophyta, Diatoms, Bacillariophycese, Mayflies, Population density.

Timber harvesting by clearcutting is a common practice in the U.S. but study of its impact on stream macroinvertebrates has been neglected. Clearcutting may alter stream biota by changing light, temperature, nutrients, sediment particle size, or food in the stream. Macroinvertebrates were sampled during late summer of 1979 in first and second order headwater streams draining both two- and three-year-old clearcuts and nearby uncut reference areas in northern New England, USA. Periphyton were sampled throughout the summer by placing microscope slides in these streams for 13-37 days. Periphyton cell densities on these slides following incubation were about six times higher in cutover than in reference streams. Green algae accounted for a higher proportion of total cell numbers in cutover than in reference streams, whereas diatoms dominated the reference streams. The macroinvertebrate density in cutover streams was 2-4 times greater than that in the reference streams, but the number of taxa collected was similar in both cutover and reference streams. Higher numbers of mayflies and/or true flies in the cutover streams accounted for the differences. Because nutrient concentrations in the cutover streams were nearly the same as those in the reference streams, these differences in macroinvertebrate and periphyton densities were apparently caused by higher light levels and temperature in the streams in the clearcuts. Leaving buffer strips along streams will reduce changes in stream biology associated with clearcutting. (Authors' abstract)
W87-05875

4D. Watershed Protection

CONSTRUCTION AND PERFORMANCE OF RIVER BANK EROSION PROTECTION STRUCTURE IN THE NIGER DELTA,
Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Inst. of Flood and Erosion Control.
T. K. S. Abam, and C. O. Okagbue.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 23, No. 4, p 499-506, November 1986. 7 fig, 2 tab, 5 ref.

Descriptors: *Construction, *Erosion control, *Banks, *Bank erosion, *Niger Delta, Performance evaluation, Erosion, Polymers, Plastics, Thalweg, Silt, Clays, Sediments, Soil types, Hydrology.

Bank erosion in the Niger Delta was minimized by the use of sand-fill embankments protected by synthetic polypropylene mattress. The success of such a protection measure depends on the properties of the dredged sand as well as the nature of the river bed and the thalweg of the river. The following conclusions are drawn: (1) the percentage of silt/clay content is a critical factor in the stability of sand embankment by hydraulic sand-fill. The percentage of the fines content to achieve stability is about 2; (2) a river bed covered by a clay layer can be a potential failure surface in a river bank protected by dredged sand embankment; (3) where the thalweg of the river is in sand, the erosive surge of water during high river stage is greatly enhanced, steepening the toes of banks from a stable slope to one which is unstable; and (4) design calculations for erosion protection structures must be backed by successful field operations. The design of a river bank protection structure should be continuous until the structure is successfully completed. (Author's abstract)
W87-05377

CUT-AND-FILL BECOMES CUT-AND-DRAIN,
For primary bibliographic entry see Field 8D.
W87-05387

SLOPE INDICATOR MEASUREMENTS OF SUBSURFACE MOVEMENT IN GULLY WALLS,
Royal Tropical Inst., Amsterdam (Netherlands).
For primary bibliographic entry see Field 2J.
W87-05524

EVALUATION OF EMBANKMENT DAMAGE AND PROTECTION,
Simons, Li and Associates, Inc., Fort Collins, CO.
Y. H. Chen, and S. Rais.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 2-38 to 2-47, 8 fig, 7 ref.

Descriptors: *Embankments, *Erosion control, *Bank protection, *Erosion, *Quantitative analysis, Earthworks, Grass, Mattresses, Geoweb, Soil cement, Enkamat, Pavement, Computer models, Model studies, Hydraulic profiles.

The objectives of this study were to conduct laboratory tests and develop a methodology to quantitatively determine embankment damage, and assess protective measures. During the study, available literature and field data were collected and analyzed. Embankment overtopping tests were conducted. The embankments used in this study are 6 ft (1.8 m) high, 10 to 22 fr (3.0 to 6.7 m) in crest width, and 3 ft (0.9 m) in length, with slope varying from 2:1 to 3:1. The embankment surfaces include both with and without protective measures (pavement, grass, mattresses, Geoweb, soil cement, Enkamat, and others). The flood overtopping conditions include overtopping depths ranging from 0.5 to 4 ft (0.15 to 1.22 m), discharges ranging from 1 to 25 cfs/ft (0.1 to 2.32 cms/m) and tailwater conditions ranging from 10% water-surface drop to free fall. A computer model was developed to determine hydraulics of overtopping flow and associated erosion damage. This model is being verified using field data and laboratory test results. The preliminary study results are presented in this paper. (See also W87-05740) (Author's abstract)
W87-05754

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SALINITY BALANCE OF THE LOWER VIRGIN RIVER BASIN, NEVADA AND ARIZONA,
Montana Univ., Missoula. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W87-05178

ACCURACY AND PRECISION OF ANALYSES FOR 2,4-D AND PICLORAM IN STREAMWATER BY TEN CONTRACT LABORATORIES,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
L. A. Norris.
Weed Science WEESA6, Vol. 34, No. 3, p 485-489, May 1986. 4 tab, 13 ref. USDA Cooperative Aid Agreement PNW-191.

Descriptors: *Water analysis, *Performance evaluation, *Herbicides, *Stream pollution, *Laboratories, *Chemical analysis, *Quality control, Monitoring.

In a test of laboratory precision and acuracy, streamwater samples fortified with 2,4-D and picloram were submitted in quadruplicate for residue analysis to ten laboratories that analyze samples for a fee. Varying amounts of the herbicides were detected by eight laboratories and two reported no residues. Analyses from most laboratories had a negative bias ranging from -2% to -92%, although a positive bias appeared in a few instances. Precision was highly variable and the coefficient of variation ranged from 3.4 to 200%. The accuracy range in 19 of 20 cases was plus or minus 100 to 78% for for 2,4-D and plus or minus 100 to 114% for picloram, respectively. Results show that careful selection of contract laboratories and a quality assurance program should be part of monitoring for water contamination with herbicides. (Author's abstract)
W87-05262

SEASONAL ANALYSIS OF VOLATILE ORGANIC BIOGENIC SUBSTANCES (VOBS) IN FRESHWATER PHYTOPLANKTON POPULATIONS DOMINATED BY DINOBRYON, MICROCYSTIS AND APHANIZOMENON,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
F. Juttner, B. Hoflacher, and K. Wurster.
Journal of Phycology JPYLAJ, Vol. 22, No. 2, p 169-175, June 1986. 7 fig, 1 tab, 18 ref.

Descriptors: *Seasonal variation, *Pollutant identification, *Phytoplankton, *Phytotoxicity, *Eutrophic lakes, Eutrophication, Volatile solids, Organic compounds, Lake Federsee, Water sampling, Succession, Gas chromatography, Spectral analysis, Lakes.

For one year, the volatile organic biogenic substances (VOBS) found in the water of the eutrophied shallow lake, Lake Federsee, were determined by gas chromatographic and mass spectrometric methods. The substances detected belonged to nor-carotenoids, terpenoids, unsaturated hydrocarbons, ketones, and aldehydes. The occurence of particular VOBS correlated with the frequency with which certain phytoplankton species were recorded. The latter showed a well developed succession in that year. The following correspondences were found: Beta-cyclocitral and Microcystis; heptadec-cis-5-ene and Oscillatoria redekei; geosmin and argosmin and Aphanizomenon gracile; hepta-trans,cis 2,4-dienal, deca-trans,cis 2,4-dienal and Dinobryon; octa-trans,cis 1,3,5-triene and Asterionella formosa. Dictyopterenes and ectocarpene were only detected in high amounts in one sample obtained in August. The VOBS exhibited marked dynamics in the lake and usually were rapidly eliminated from the water body. (Author's abstract)
W87-05316

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 3, DRINKING-WATER QUALITY CONTROL IN SMALL-COMMUNITY SUPPLIES.
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 5G.
W87-05334

RESEARCH NEEDS ASSOCIATED WITH TOXIC SUBSTANCES IN WASTEWATER TREATMENT SYSTEMS.
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-05335

ACIDITY OF DEW,
Ford Motor Co., Dearborn, MI.
For primary bibliographic entry see Field 5B.
W87-05340

BACTERIAL CONTAMINATION OF AMBULANCE OXYGEN HUMIDIFIER WATER RESERVOIRS: A POTENTIAL SOURCE OF PULMONARY INFECTION,
Medical Coll. of Virginia, Richmond. Dept. of Pharmacology.
J. L. Cameron, W. A. Reese, V. S. Tayal, R. F. Clark, and D. Kelso.
Annals of Emergency Medicine AEMED3, Vol. 15, No. 11, p 1300-1302, November 1986. 2 tab, 8 ref.

Descriptors: *Pollutant identification, *Hospitals, *Cultures, *Human diseases, *Public health, *Humidifiers, *Pathogenic bacteria, *Infection, *Bacterial analysis, Diseases, Bacteria, Pseudomonas, Klebsiella, Staphylococcus, Bacterial analysis, Water analysis, Contamination.

The risk and benefit of oxygen humidification during ambulance transport is unknown. Water was cultured in plastic multiple-use bottles of humidifiers on 30 randomly selected area ambulances during November 1985. There were 22 positive cultures. Potentially pathogenic bacteria were found in nine samples (four Pseudomonas maltophilia, three Pseudomonas aeruginosa, one Klebsiella pneumoniae, and one Staphylococcus epidermidis). Assuming that the water in ambulance humidifiers should have been sterile, the findings are statistically significant ($P < .01$). Because there is no evidence that humidification is of benefit for nonintubated patients receiving oxygen at flow rates of 4 L/min or less when environmental humidity is adequate, it is recommended that such patients should receive oxygen without humidification during ambulance transport. All other patients requiring oxygen during ambulance transport should continue to receive humidified oxygen. An alternative is to replace the multiple-use humidifier reservoir with single-use sterile disposable devices, which cost approximately $2.00 per unit. (Author's abstract)
W87-05343

EXTRACTION AND PURIFICATION OF TOXIC PEPTIDES FROM NATURAL BLOOMS AND LABORATORY ISOLATES OF THE CYANOBACTERIUM MICROCYSTIS AERUGINOSA,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
W. P. Brooks, and G. A. Codd.
Letters in Applied Microbiology, Vol. 2, No. 1, p 1-3, 1986. 1 fig, 1 tab, 11 ref.

Descriptors: *Sample preparation, *Peptides, *Pollutant identification, *Chemical analysis, *Bacteria, *Microcystis, *Eutrophication, *Water pollution sources, *Water analysis, *Bioassay, Culturing techniques, Analysis, Isolation, Chromatography, Methanol, Reagents, Assay, Toxicity, Extraction.

A rapid extraction and purification procedure is described for preparing toxic peptides from freshwater blooms and laboratory isolates of Microcystis aeruginosa. Discrete toxin peaks were obtained by extraction with methanol butanol followed by C18 cartridge concentration, gel filtration, and high performance liquid chromatography. Elution profiles for the laboratory isolates and bloom extracts are compared and the applicability of the method for detecting cyanobacterial toxins in natural waters is discussed. Hepatotoxins from other Microcystis isolates and blooms are being purified to permit detailed comparison of the toxins from different freshwater and laboratory clones. Further simplification of the procedure is also under development. (Author's abstract)
W87-05349

DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN NATURAL WATERS BY THIN-LAYER CHROMATOGRAPHY AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Universita degli Studi 'La Sapienza', Rome (Italy). Dept. of Chemistry.
G. Cartoni, F. Coccioli, M. Ronchetti, L. Simonetti, and L. Zoccolillo.
Journal of Chromatography JOCRAM, Vol. 370, No. 1, p 157-163, November 1986. 2 fig, 2 tab, 38 ref.

Descriptors: *Sample preparation, *Chemical analysis, *Pollutant identification, *Hydrocarbons, *Aromatic compounds, *Chromatography, *Thin layer chromatography, *Indicators, *Water analysis, Reagents, Sampling, Separation techniques, Extraction, Detection limits.

A procedure is described for the determination in natural waters of the six polycyclic aromatic hydrocarbons (PAHs) listed by WHO as indicators of pollution. The method consists of continuous liquid-liquid extraction, separation of the PAH fraction by thin-layer chromatography and reversed phase high-performance liquid chromatography with a spectrofluorimetric detector. The method has been applied to ulfiltered samples of river and sea waters with PAH levels below 0.1 ng/l. PAHs included fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, and indeno(1,2,3-cd)pyrene. Reproducibility was determined by taking five sub-samples of the same sample of River Tiber water and executing three HPLC analyses on each. Recovery was determined by spiking samples of previously extracted distilled water with a solution of PAHs at a concentration of 5 ng/l each; values of 85% were obtained. (Author's abstract)
W87-05351

NOVEL ACTINOMYCETE ISOLATED FROM BULKING INDUSTRIAL SLUDGE,
Alabama Univ. in Birmingham. Dept. of Biology.
For primary bibliographic entry see Field 5D.

W87-05398

OCCURRENCE AND DISTRIBUTION OF HALOPHILIC VIBRIOS IN SUBTROPICAL COASTAL WATERS OF HONG KONG,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
K.-Y. Chan, M. L. Woo, K. W. Lo, and G. L. French.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1407-1411, December 1986. 1 fig, 3 tab, 42 ref.

Descriptors: *Halophilic vibrios, *Coastal waters, *Population dynamics, *Species composition, *Hong Kong, *Pathogens, Pollutant identification, Sugars.

Several marine species of the genus Vibrio are pathogenic for man, and some have caused fatal infections. Most of the infections with halophilic vibrios are known to be associated with either consumption of seafood or exposure to marine environments. Infection due to Vibrio parahaemolyticus is world wide in distribution and is the main cause of summer diarrhea in Japan. The summer occurrence and distribution of halophilic vibrios in the subtropical coastal waters of Hong Kong were investigated. The density of vibrios in six sample sites ranged from 90 to 6,700 per ml, which made up 0.41 to 40% of the total bacterial populations of these sample sites. The sucrose-positive vibrios were found to be much more common (88% of total vibrios) than the sucrose-negative ones. A total of 48 strains belonging to six Vibrio species were fully characterized. Among these, Vibrio alginolyticus was the most frequently isolated, followed by V. parahaemolyticus, V. harveyi, V. vulnificus, V. campbellii, and V. fluvialis. The finding that eight of the nine strains of V. harveyi showed a positive Kanagawa reaction warrants further study. (Alexander-PTT)
W87-05402

MEASUREMENTS OF THE CHEMICAL COMPOSITION OF CLOUDWATER AT A CLEAN AIR SITE IN CENTRAL SCANDINAVIA,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
J. Ogren, and H. Rodhe.
Tellus TELLAL, Vol. 38B, No. 3/4, p 190-196, July-September 1986. 4 fig, 4 tab, 13 ref. NFR Project G-GU 8428-100.

Descriptors: *Water analysis, *Chemical composition, *Cloudwater, *Scandanavia, *Rainfall, *Path of pollutants, Transport, Wind speed, Aerosols, Sulfates, Atmospheric chemistry.

As awareness of the importance of clouds to atmospheric chemistry has increased, so has the amount of reported data on the chemical composition of cloudwater. Studies of cloudwater composition to date have been concentrated on clouds in anthropogenically-influenced settings, with very little information available on the chemical composition of cloudwater in remote areas. A total of 179 samples of cloudwater were obtained during the summers of 1983 and 1984 at a clean-air site in the mountains of central Scandinavia. Impaction of droplets on teflon-coated wires provided samples with a time resolution of 5-30 min. Supporting data include cloud liquid water content, rainwater composition, aerosol number concentration, wind speed and direction, and 48-h isobaric trajectories. Collected samples were analyzed for pH, Na(+), K(+), Mg(+), NH4(+), Cl(-), NO3(-), and SO4(2-). A wide range of concentrations were encountered, with, for example, sulfate concentrations ranging from 1 to 1600 micro-eq/L. Transport of air from remote regions (north Atlantic Ocean, Arctic) is shown to be associated with the very low concentrations, while the high concentrations occurred in conjunction with transport from industrial regions in Europe. Median clean-air concentrations in Arctic air, calculated from cloudwater composition and liquid water content, were 3 pptv ammonia (gas and aerosol combined), 6 pptv nitrate (gas and aerosol), and 30 ng/cu m sulfate. (Alexander-PTT)
W87-05405

HISTOCHEMICAL DEMONSTRATION OF TWO MERCURY POOLS IN TROUT TISSUES: MERCURY IN KIDNEY AND LIVER AFTER MERCURIC CHLORIDE EXPOSURE,
Aarhus Univ. (Denmark). Inst. of Anatomy.
E. Baatrup, M. G. Nielsen, and G. Danscher.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 3, p 267-282, December 1986. 16 fig, 31 ref.

Descriptors: *Mercury, *Tissue analysis, *Path of pollutants, *Trout, *Isotope studies, *Bioaccumulation, *Autometallography, Monitoring, Heavy metals, Selenium, Accumulation, Sample preparation, Metabolism.

Fish accumulate mercury as a result of an efficient uptake and a slow rate of elimination. The concentration of mercury attained by a specific tissue depends on the mercurial in question, its concentration in water or food, time of exposure, and the rate of metabolism or elimination from the tissue. Juvenile rainbow trout (Salmo gairdneri) were exposed to 100 ppb mercury (as HgCl2) in the water for 14 days. Concentrations of mercury in water and fish organs were monitored using radiolabeled mercury. Tissues from kidney and liver were fixed, and sections were developed by autometallography, a method whereby accumulations of mercury sulfides and/or mercury selenides are silver amplified. In the kidney, mercury was found within lysosomes and extracellularly in the basal lamina of proximal tubules. In the liver, mercury was found within lysosomes of the hepatocytes. Additional groups of mercury-exposed trout were subjected to selenium (as Na2SeO3), administered intraperitoneally 2 hr before fixation. Following this treatment, additional mercury could be visualized in the kidney circulatory system, including glomeruli, and in the nucleus and endoplasmic reticulum of liver cells. It is suggested that the mercury visualized prior to selenium treatment represents inorganic mercury, while additional mercury visualized after selenium administration represents an organic form. (Alexander-PTT)
W87-05413

HEXACHLOROBENZENE, OCTACHLOROSTYRENE AND OTHER ORGANOCHLORINE COMPOUNDS IN WASTE WATER FROM INDUSTRIAL HIGH-TEMPERATURE PROCESSES INVOLVING CHLORINE,
For primary bibliographic entry see Field 5B.
W87-05456

ALGAE FLUORESCENCE AUTOMETER, A COMPUTERIZED BIOASSAY (ALGEN-FLUORESZENZ-AUTOMETER, EINE COMPUTERGESTEUERTE BIOTEST-MESSAPPARATUR),
For primary bibliographic entry see Field 7B.
W87-05461

SIMPLE DETERMINATION OF VOLATILE HALOGENATED OR AROMATIC HYDROCARBONS IN SOIL AND SLUDGE SAMPLES BY HEAD SPACE GAS-CHROMATOGRAPHY (EINFACHE BESTIMMUNG LEICHTFLUCHTIGER HALOGENIERTER ODER AROMATISCHER KOHLENWASSERSTOFFE IN BODEN- UND SCHLAMMPROBEN DURCH DAMPFRAUM-GAS-CHROMATOGRAPHIE),
A. Preuss, and R. Attig.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 325, No. 6, p 531-533, November 1986. 1 tab, 3 ref.

Descriptors: *Sample preparation, *Analytical methods, *Pollutant identification, *Hydrocarbons, *Gas chromatography, *Soil chemistry, *Sludge, *Quantitative analysis, *Halogenated hydrocarbons, Pollutants, Chromatography, Soil tests, Chlorinated hydrocarbons, Solvents, Organic solvents.

A rapid and simple quantitative determination of various halogenated or aromatic solvents in soil and sludge is achieved by dispersing the sample in methylglycol (2-methoxy-ethanol), containing chlorobenzene and tribromomethane as internal standards. An aliquot of the homogeneous liquid phase is tranferred directly into a sample vial containing an excess of water, followed by gas chromatographic separation of the head-space gas. The method is independent of the content of water in the sample, and allows the determination of concentrations of, e.g. tetrachloroethene down to 10 micrograms/kg by using an ECD or 0.5 mg/kg benzene by using an FID as detector. (Author's abstract)
W87-05474

DETERMINATION OF SELENIUM IN SEDIMENTS BY FLUORIMETRY WITH 2,3-DIAMINONAPHTHALENE AFTER AN IMPROVED PRETREATMENT BY TELLURIUM COPRECIPITATION,
Nagoya City Environmental Pollution Research Inst. (Japan).
K. Itoh, M. Nakayama, M. Chikuma, and H. Tanaka.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 325, No. 6, p 539-543, November 1986. 3 fig, 6 tab, 13 ref.

Descriptors: *Pollutant identification, *Selenium, *Fluorometry, *Sediments, *Sample preparation, *Analytical methods, *Tellurium coprecipitation, Pollutants, Estuaries, Nagoya, Japan, Ions, Industrial wastes.

An improved fluorimetric method for the determination of selenium in estuary sediments and sedimentary core samples is described. For the separation of selenium, coprecipitation with tellurium-ascorbic acid method gave satisfactory results. The status of the pollution caused by selenium in the Nagoya area, which is one of the most industrially active areas in Japan, was estimated based on the results obtained with this method. Several micrograms/g of selenium were determined in the sediments. Interferences by foreign ions were eliminated by the coprecipitation procedure. Selenium added was recovered by 95-101%. (Author's abstract)
W87-05475

PROBLEMS IN MEASURING WATER SAMPLES OF DIFFERENT SALT CONTENT BY ICP-AES,
Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Anorganische Chemie und Kernchemie.
R. Speer, P. Hoffmann, and K. H. Lieser.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 325, No. 6, p 558, November 1986.

Descriptors: *Inductively coupled plasma, *Water analysis, *Pollutant identification, *Groundwater, *Atomic emission spectrometry, *Salinity, Pollutants, Salts, Technology, Saline water, Groundwater pollution, Water sampling.

Atomic emission spectrometry with inductively coupled plasma (ICP-AES) is widely used for analysis and characterization of groundwaters with different compositions. If measurements of the various samples were interspersed with measurements of backround and standards, no problems arose. However, if saline and non-saline samples were measured in succession, irregularities appeared. The cause of the problem was deduced to be deposition of salt particles in the nebulizer gas nozzle after many other described possibilities were explored. It was found that briefly stopping the gas flow and starting it up again opened the nozzle and solved the problem. (Wood-PTT)
W87-05476

DETERMINATION OF GENOTOXIC POLYCYCLIC AROMATIC HYDROCARBONS IN A SEDIMENT FROM THE BLACK RIVER (OHIO),
Brigham Young Univ., Provo, UT. Dept. of Chemistry.
W. R. West, P. A. Smith, G. M. Booth, S. A. Wise, and M. L. Lee.
Archives of Environmental Contamination and

Toxicology AECTCV, Vol. 15, No. 3, p 241-249, 1986. 6 fig, 8 tab, 19 ref.

Descriptors: *Pollutant identification, *Sediments, *Polycyclic aromatic hydrocarbons, *Black River, *Genotoxicity, *Mutagenicity, *Water pollution effects, Catfish, Chromatography, Spectral analysis, DNA, Ames test, Hepatoma.

The potential health hazards associated with the use of fossil fuels underscores the need to monitor waste effluents resulting from their use. These effluents may be rich in polycyclic aromatic hydrocarbons (PAH), some of which are potent carcinogens. If these waste effluents are introduced into aquatic systems, the PAH will accumulate in the sediments. PAH were identified as genotoxic pollutants in sediment from the Black River, Ohio, where a high incidence of hepatoma was observed in brown bullhead catfish (Ictalurus nebulosus). Subfractions of PAH based on the number of aromatic carbons were isolated from the PAH fraction of a Black River sediment extract. Ten subfractions were analyzed by capillary column gas chromatography-mass spectrometry, tested for mutagenicity using the Ames assay, and tested for induction of unscheduled DNA synthesis (UDS) in primary rat hepatocytes. The Ames assay indicated significant mutagenic activity in fractions which contained PAH with 4-6 aromatic rings; the majority of the activity was found in the fraction composed of 5-ring compounds. UDS was also significant in the same fractions, although the greatest genotoxicity was observed in the cata-condensed and peri-condensed 4-ring fractions which contained a large amount of alkylated-PAH. (Alexander-PTT)
W87-05499

ENTEROVIRUSES OF HUMAN ORIGIN AND FAECAL COLIFORMS IN RIVER WATER AND SEDIMENTS DOWN STREAM FROM A SEWAGE OUTFALL IN THE TAIERI RIVER, OTAGO,
Otago Univ., Dunedin (New Zealand). Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W87-05517

SURVEY OF LEAD, CADMIUM AND FLUORIDE IN HUMAN MILK AND CORRELATION OF LEVELS WITH ENVIRONMENTAL AND FOOD FACTORS,
Health and Welfare Canada, Ottawa (Ontario). Food Research Div.
For primary bibliographic entry see Field 5B.
W87-05550

PHOTOMETRIC DETERMINATION OF TIN, ZIRCONIUM, NIOBIUM, AND TANTALUM IN SEA ALGAE,
Fiziko-Khimicheskii Inst., Odessa (USSR).
L. I. Vinarova, M. A. Chernysheva, and V. P. Antonovich.
Soviet Progress in Chemistry, Vol. 51, No. 8, p 79-81, August 1986. 6 ref. Translated from Ukrainskii Khimicheskii Zhurnal, Vol. 51, No. 8, p 857-859, 1985.

Descriptors: *Pollutant identification, *Path of pollutants, *Analytical methods, *Tissue analysis, *Black Sea, *Algae, *PLankton, *Photometry, Plant physiology, Metals, Heavy metals.

Photometric methods were developed and employed to determine Sn, Zr, Nb, and Ta in Phyllophora costate from the Black Sea. The procedures employed for the determination of each of these elements are described. The results were as follows (data as % of ash): Sn, 0.0011; Zr, 0.0007; Nb, 0.00017; and 0.00012. The order of magnitude of the Sn and Zr contents corresponds to their amounts in the ash of Black Sea plankton. (Rochester-PTT)
W87-05585

VIRULENCE CHARACTERISTICS OF AEROMONAS SPP. IN RELATION TO SOURCE AND BIOTYPE,
Tasmania Univ., Hobart (Australia). Dept. of Pathology.
S. M. Kirov, B. Rees, R. C. Wellock, J. M. Goldsmid, and A. D. Van Galen.
Journal of Clinical Microbiology JCMIDW, Vol. 24, No. 5, p 827-834, November 1986. 5 fig, 1 tab, 57 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Pollutant identification, *Human diseases, *Aeromonas, *Toxins, Australia, Diarrhea, Bacterial physiology, Pathogens, Taxonomy.

Biochemical characteristcs and virulence-associated properties - exotoxin production (hemolysin, enterotoxin), ability to grow at 43 C, and possession of pili - were determined for 105 Tasmanian (Australia) isolates of Aeromonas spp. Of these, 43 were from clinical specimens (>75% diarrhea associated) and 62 were from water. A. sobria comprised 35% of the clinical isolates and 15% of the water isolates; A. hydophila comprised 56 and 79%, and A. caviae comprised 9 and 5%. Forty-two percent of the clinical isolates and 15% of the environmental isolates were enterotoxigenic (by the suckling mouse assay); these levels were significantly lower than those found in warmer environments. The majority (74%) of enterotoxigenic isolates were A. sobria. Enterotoxin-producing isolates possessed three or more of the following properties: Voges-Proskauer positive, did not hydrolyze arabinose, lysine decarboxylase positive, grew at 43 C, and produced large amounts of hemolysin (titer > 128). Thus, the biochemical scheme proposed by Burke and others in 1982 for identifying enterotoxigenic isolates appears to have wide applicability. Environmental enterotoxigenic isolates had numerous pili, but these appeared to be lost once infection was established, as similar isolates from patients with diarrhea were poorly piliated. (Author's abstract)
W87-05588

CHANGING CONCEPTS AND IMPROVED METHODS FOR EVALUATING THE IMPORTANCE OF PCBS AS DREDGED SEDIMENT CONTAMINANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
V. A. McFarland, J. U. Clarke, and A. B. Gibson.
Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 as ADA 174177 PC A02 MF A01. Army Corps of Engineers Miscellaneous Paper D-86-5, Final Report, September 1986. 19 p, 5 fig, 2 tab, 35 ref, append.

Descriptors: *Polychlorinated biphenyls, *Sediment contamination, *Dredging, Path of pollutants, Water pollution sources, Fate of pollutants, Aroclors, Chemical analysis, Hudson River, Tissue analysis, Toxicity, Bioaccumulation.

Interpretation of the potential ecological effects of disposing Polychlorinated biphenyl (PCB)-contaminated sediments in open water or using other methods is a persistent difficulty in the preparation of environmental impact statements and other documentation necessary for informed decisionmaking. However, understanding of the nature and behavior of PCBs as environmental contaminants has progressed rapidly within the scientific community with advances in analytical technology. Evaluations of PCBs in environmental samples by quantitation as Aroclors or as total PCBs are of limited value because of degradation and differential affinities of congeners for various environmental compartments. PCBs that entered the environment as identifiable Aroclor mixtures are altered by these physical, chemical, and biological processes and cannot properly be identified by comparison with Aroclor analytical standards. Comparisons of PCB-contaminated Hudson River sediments, along with water and organism tissue samples exposed to those sediments, with Aroclor standards demonstrate the frequent lack of correspondence in PCB components between Aroclors and environmental samples. Evaluation of PCBs in environmental samples can be accomplished by quantitation as totals in the isomer groups di through decachlorobiphenyl (two to ten chlorines per molecule). This has the advantage of indicating the relative concentrations of the groups potentially containing the most toxic and bioaccumulating congeners. Recent advances in analytical techniques are making the analysis of individual congeners more feasible. Attention can be focused specifically on the PCB components that are important on the basis of toxicity, persistence, and prevalence, allowing a more accurate assessment of the environmental effects of various dredged material disposal options than is available. (Lantz-PTT)
W87-05599

LOW-COST LAB WORK,
For primary bibliographic entry see Field 5G.
W87-05611

GEOCHEMICAL INVESTIGATIONS OF POLYCHLORINATED DIBENZO-P-DIOXINS IN THE SUBSURFACE ENVIRONMENT AT AN ABANDONED WOOD-TREATMENT FACILITY,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W87-05620

ORGANIC SUBSTANCES IN THE RAINFALL OF LAKE SUPERIOR: 1983,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
W. M. J. Strachan.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 677-683, 1985. 1 fig, 4 tab, 26 ref.

Descriptors: *Pollutant identification, *Water analysis, *Rainfall, *Lake Superior, *Precipitation, Pesticides, Organic compounds, Lakes, Pollution load.

In 1983, sampling for organic substances in rainfall was undertaken at two, open-lake locations at opposite ends of Lake Superior-Isle Royale and Caribou Island. Triplicate samples, averaging 22 liters, were collected in each time period (approximately 6 weeks) and analyzed for alpha-BHC, lindane, heptachlor epoxide, dieldrin, endrin, DDT residues, methoxychlor, polychlorinated biphenyls and hexachlorobenzene, alpha- and delta-chlordane, mirex and toxaphene were also investigated but were not found in any of the samples. Concentrations of these compounds ranged from 0.01 to 65 ng/L. The east side of the lake received considerably lower concentrations in rainfall (on average, roughly 65% less) and the levels of most of the observed substances were higher at both locations in the spring and early summer. Estimates of direct loadings to the lake were made using volume-weighted concentrations. The highest was for alpha-BHC at 860 kg/year and the lowest for hexachlorobenzene at 3.7 kg/year; the loading estimate for polychlorinated biphenyls was 300 kg/year. (Author's abstract)
W87-05624

NEW FATHEAD MINNOW (PIMEPHALES PROMELAS) SUBCHRONIC TOXICITY TEST,
Environmental Research Lab.-Duluth, MN.
T. J. Norberg, and D. I. Mount.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 711-718, 1985. 1 fig, 5 tab, 28 ref.

Descriptors: *Bioindicators, *Minnows, *Toxicity tests, *Water pollution effects, *Performance evaluation, *Sublethal effects, *Effluents, *Toxicity, Costa, Larvae, Pollutants, Zinc, Copper, Dursban, Fish, Population exposure.

The most commonly used test for evaluating the toxicity of effluents to fish and invertebrates has been the acute lethality test. However, effluents frequently are not acutely toxic, and so assessing the sublethal effects on fish and invertebrates is important. Described herein is a rapid method to estimate the chronic toxicity of effluents to the fathead minnow (Pimephales promelas). Tests are initiated using newly hatched minnow larvae and

are run for 7 d under static-renewal conditions. It is a cost-effective, simple, short-term toxicity test, and survival and growth are the measures of effects. Approximately 70 tests using this technique were run with various types of effluents. Included in this article are results from representative effluent tests and also from tests conducted using Durban, zinc and copper. The results indicate that this subchronic toxicity test gives a good estimate of chronic toxicity. (Author's abstract)
W87-05628

INFLUENCE OF MICROBIAL ADAPTATION ON THE FATE OF ORGANIC POLLUTANTS IN GROUND WATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W87-05629

PLASMA LEUCINE AMINONAPHTHYLAMIDASE AS AN INDICATOR OF ACUTE SUBLETHAL TOXICANT STRESS IN RAINBOW TROUT,
Waterloo Univ. (Ontario). Dept. of Biology.
D. G. Dixon, C. E. A. Hill, P. V. Hodson, E. J. Kempe, and K. L. E. Kaiser.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 789-796, 1985. 6 tab, 22 ref. Dept. of Fisheries and Oceans Contract DDS No. 01SE.FP312-2-0041.

Descriptors: *Water pollution effects, *Bioindicators, *Trout, *Enzymes, *Bioassay, *Sublethal effects, *Population exposure, *Blood analysis, Fish, Organic compounds, Toxicity, Stress, Histopathology.

Leucine aminonaphthylamidase (LAN) is a lysosomal enzyme that appears in blood plasma after cell death. Levels of plasma LAN (PLAN) were assayed to quantify toxicant stress in rainbow trout in a series of experiments. Blood samples were taken from groups of fish weighing 80 to 100 g following intraperitoneal (i.p.) and/or waterborne exposure to p-methylphenol (PMP) or carbon tetrachloride (CCl4). The duration of postinjection holding significantly affected PLAN activity in control and PMP-dosed rainbow trout; the largest increases occurred after 96 h. There were significant correlations between dose and PLAN activity after both PMP and CCl4 injection. PLAN levels of fish injected with PMP at doses of 0.075 to 0.75 of the 96-h i.p. LD50 were elevated by 27 to 63% relative to controls 96 h after injection. PLAN levels of fish injected with CCl4 at doses of 0.18 to 0.79 of the i.p. LD50 were elevated by 38 to 135% relative to controls 48 h after injection. Exposure of fish to a water borne concentration of 0.028 mM PMP (0.41 96-h LC50) significantly increased PLAN activity after 48, 96 and 192 h; activities increased by 38 to 87% relative to controls. Elevated PLAN activity was strongly correlated with decreased plasma protein levels. The temperature and duration of plasma storage affected the measured PLAN activity of control and PMP-dosed rainbow trout. While diet modified PLAN activity, the gender of immature fish had no effect. Hepatic lesions visible by light microscope were observed with waterborne PMP exposure; parenchymatous edema was closely associated with increased liver somatic index. There were, however, no visible lesions or changes in the index associated with the pulse i.p. doses of PMP and CCl4. In these cases, biochemical lesions preceded any evidence of histopathology. (Author's abstract)
W87-05637

SHORT-TERM FISH AND AMPHIBIAN EMBRYO-LARVAL TESTS FOR DETERMINING THE EFFECTS OF TOXICANT STRESS ON EARLY LIFE STAGES AND ESTIMATING CHRONIC VALUES FOR SINGLE COMPOUNDS AND COMPLEX EFFLUENTS,
Thomas Hunt Morgan School of Biological Sciences, Lexington, KY.
W. J. Birge, J. A. Black, and A. G. Westerman.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 807-821, 1985. 12 tab, 32 ref. EPA Contract 68-01-5052; subcontract 2800-03-218; EPA Cooperative agreement CR-810001-01-1.

Descriptors: *Water pollution effects, *Population exposure, *Bioindicators, *Toxicity tests, *Embryos, *Larvae, *Toxicity, Effluents, Survival, Stress, Cadmium, Heavy metals, Statistical analysis, Field tests, Sensitivity analysis, Performance evaluation.

A short-term embryo-larval test is described for use with single compounds or complex effluents. Exposure was initiated soon after fertilization and maintained for 4 d after hatching, which gave an exposure period of 6 to 8 d for a number of fish and amphibian species. Test responses included mortality and teratogenesis. Probit analysis was used to calculate median lethal (LC50) and threshold (LC1) concentrations. Standard statistical tests also were performed to determine no observed effect concentrations. Multiple tests were performed with cadmium as the reference toxicant, using continuous-flow and static-renewal procedures; results substantiated high precision and good repeatability. Cadmium LC1 values agreed closely with cadmium chronic values determined in life-cycle studies. The review of published data also supported close correlations between LC1s and chronic values for metals. The procedure also worked satisfactorily for a multiple-species test in which eggs of three species were maintained in mixed populations using the same exposure chambers. The test for effluent biomonitoring was further evaluated in two major field studies. As compared with 96-h flow-through acute tests with the fathead minnow, the short-term embryo-larval test was decidedly more sensitive and reliable for characterizing the toxicity of complex effluents. (Author's abstract)
W87-05639

CHARACTERIZATION AND EVALUATION OF JP-4, JET A AND MIXTURES OF THESE FUELS IN ENVIRONMENTAL WATER SAMPLES,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
A. J. Roberts, and T. C. Thomas.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 3-11, January 1986. 11 fig, 2 tab, 3 ref.

Descriptors: *Pollutant identification, *Water analysis, *Analytical methods, *Gas chromatography, *Groundwater, *Fuels, Hydrocarbons, Solvents, Extraction, Organic compounds.

Capillary gas chromatographic data can be used to distinguish between JP-4 and commercial Jet A fuels that have contaminated groundwater. This is accomplished from chromatographic patterns by using normalized area percents of the C-15 and C-16 n-alkane components. Analyses of the neat fuels, mixtures of the neat fuels and of their solvent extract from water were performed. Analyses of contaminated groundwaters have identified the presence of jet fuel and other distillate fuels similar to diesel fuel. Even with the complex nature of these fuels, percent amounts of each fuel present as a contaminant could be determined. This technique may prove useful in determining the party responsible for pollution of groundwater. (Author's abstract)
W87-05642

EXHAUSTIVE STEAM DISTILLATION EXTRACTION OF AROMATIC ORGANICS FROM RAINBOW TROUT AND WATER,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
J. S. Meyer, and G. Linder.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 2, p 155-159, February 1986. 3 tab, 9 ref. DOE Contract ET-78-C-03-1761; EPA Cooperative agreement CR808671.

Descriptors: *Sample preparation, *Steam distillation, *Extraction, *Aromatic compounds, *Trout, *Water analysis, *Analytical methods, *Path of pollutants, *Bioaccumulation, Lipids, Fish, Effluents, Organic compounds, Pollutants.

In evaluating the potential environmental hazards of complex chemical mixtures and effluents, it is often desirable to determine the bioaccumulation potential of a wide range of organic compounds and their metabolites using a relatively rapid screening procedure. Although various techniques have been developed to extract organics from fish, many are specific for individual chemical classes and are relatively labor-intensive for use in initial bioaccumulation screening. Exhaustive steam distillation extracted several intermediate molecular weight organic chemicals effectively from rainbow trout, but a high molecular weight organic, benzo(a)pyrene, was not extracted. Fish lipids that do not steam-distill appear to retain extremely lipophilic organics in the boiling flask. Therefore, exhaustive steam distillation should be used cautiously in screening effluents for chemicals that are bioaccumulated. (Alexander-PTT)
W87-05652

EFFECTS OF SAMPLES STORAGE ON A COPPER-SPIKED FRESHWATER SEDIMENT,
Corvallis Environmental Research Lab., OR.
K. W. Malueg, G. S. Schuytema, and D. F. Krawczyk.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 245-253, March 1986. 3 tab, 17 ref.

Descriptors: *Sample preservation, *Copper, *Sediments, *Toxicity, *Cladocera, *Sample storage effects, Freezing, Daphnids, Pest, Mortality, Survival.

Freshwater sediment from an Oregon lake was spiked with copper in the laboratory to study the effect of storage on copper toxicity. Peat moss was added to enhance the carbon content of a portion of the sediment. One-half of the sediment samples were stored at 5 C while the other half were frozen (-20 C). At intervals up to 25 weeks, samples were brought to 20 C and 48-h toxicity tests were conducted in 1-liter beakers (200 ml sediment, 800 ml water) using the cladoceran Daphnia magna Straus. Copper released into the water from the sediment stored at 5 C increased over the first 8 weeks of storage, then decreased. Freezing the sediment attenuated the release of total and soluble copper into the overlying water, resulting in low or no toxicity to daphnids. Based on total copper concentrations in the overlying test water, LC50s ranged from 7 to 44 microgram(ug)/L in sediments without peat and from 52 to 96 ug/L in sediments with added peat. Soluble copper LC50s for the same test waters ranged from 3 to 18 and from 25 to 68 ug/L, respectively. No LC50s could be calculated from the frozen sediment tests because of low mortality. Freezing is not recommended as a storage procedure because of its undependability in preserving sediment integrity for toxicity tests. (Author's abstract)
W87-05657

DENITRIFICATION IN GROUNDWATERS, PRINCIPLES AND METHODS FOR ITS IDENTIFICATION: A REVIEW (LA DENITRIFICATION DANS LES EAUX SOUTERRAINES, PRINCIPES ET METHODES DE SON IDENTIFICATION: UNE REVUE),
Paris-6 Univ. (France). Lab. de Biogeochmie des Isotopes Stables.
A. Mariotti.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 1-23, November 1986. 11 fig, 2 tab, 45 ref.

Descriptors: *Reviews, *Denitrification, *Groundwater, *Oxidation-reduction potential, *Dissolved dinitrogen, *Isotopic tracers.

A bibliographical synthesis on possible methods for the identification of denitrification in groundwaters is presented. Their condition of application and limits are discussed. The following methods are considered: (1) the hydrogeochemical method allows the location of the denitrification process in a redox gradient generating a sequence of oxidation-reduction reactions; (2) the dissolved dinitrogen oversaturation method; and (3) the isotopic method using 15N natural isotope abundance trac-

ing. Denitrification is identified through the induced isotope fractionation between substrate (nitrate) and product (dinitrogen) of the reaction. (Author's abstract)
W87-05843

QUANTITATIVE EXTRACTION AND CONCENTRATION OF SYNTHETIC WATER-SOLUBLE ACID DYES FROM AQUEOUS MEDIA USING A QUININE-CHLOROFORM SOLUTION,
Tokyo Coll. of Pharmacy (Japan). Lab. of Drug Metabolism and Toxicology.
For primary bibliographic entry see Field 7B.
W87-05881

PRECONCENTRATION OF TRACE ELEMENTS FROM AQUEOUS SOLUTIONS BY OSMOSIS,
Missouri Univ.-Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W87-05882

PROPERTIES OF AND HEAVY METAL COMPLEXATION BY AQUEOUS HUMIC EXTRACTS,
Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Bodenkunde.
W. R. Fischer.
Zeitschrift fuer Pflanzenernahrung und Bodenkunde ZPBOAL, Vol. 149, No. 4, 399-410, August 1986. 9 fig, 1 tab, 21 ref.

Descriptors: *Heavy metals, *Humic extracts, *Extraction, Soil absorption capacity, Soil chemistry, Soil water, Soil stability, Soil chemical properties, Soil physical properties, Cadmium, Copper, Lead.

Aqueous extracts of terrestrial and underwater soils were prepared by Soxhlet extractions at temperatures between 100 and 37 C (under reduced pressure). From the law of mass action, stability constants were derived for the complexation of Cd, Cu, and Pb by these extracts. The activity of the heavy metals was determined polarographically, whereas the concentration of acid functional groups was used for ligand activity. Visible spectra, electrical conductivity, organic matter contents, and complexation constants depended on extraction temperature as well as on soil properties. In most cases, complex stability increased with increasing pH of the polarographic medium, but sometimes maximum stability was found around pH 7. (Author's abstract)
W87-05889

DRAGONFLIES AS INDICATORS OF THE CONDITIONS OF RUNNING WATERS IN THE LOWER PARTS OF NORTHWESTERN GERMANY (LIBELLEN ALS INDIKATOREN DES ZU STANDES VON FLIESSGEWAESSERN DES NORDWESTDEUTSCHEN TIEFLANDES),
Technische Univ. Braunschweig (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 2H.
W87-05896

CROSSFLOW FILTRATION OF COLLOIDS FROM BALTIC SEA WATER,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
B. G. Whitehouse, G. Petrick, and M. Ehrhardt.
Water Research WATRAG, Vol. 20, No. 12, p 1599-1601, December 1986. 1 fig, 12 ref.

Descriptors: Descriptors :*Colloids, *Filtration, *Dissolved solids, Particulate matter, Aliphatic hydrocarbons, Ultrafiltration, Baltic Sea.

Samples of Baltic Sea water were processed by glass fiber filtration followed by crossflow filtration, resulting in a particulate and colloidal fraction. Crossflow filtration provided necessary filtration rates (up to 11-12 l/h) without contributing interfering contaminants. It is suggested that photo-oxidation, as employed here, did not completely oxidize colloidal organic matter, thus its concentration was underestimated. Percentages of organic carbon and aliphatic hydrocarbons in the colloidal size range were calculated, but should be viewed as semi- quantitative due to observed inaccuracies introduced by the analytical procedures of filtration and organic carbon analyses. Traditional methods of filtration do not allow accurate quantification of the amount of colloidal matter present in seawater. Ultrafiltration methods are presently impractical due to filtration time and contamination problems. The crossflow method described here has the potential of overcoming the problem of filtration time. (Airone-PTT)
W87-05920

VIRUS DETECTION IN WATER BY ULTRAFILTRATION,
Queen Elizabeth II Medical Center, Nedlands (Australia). Virology Section.
J. Jansons, and M. R. Bucens.
Water Research WATRAG, Vol. 20, No. 12, p 1603-1606, December 1986. 2 fig, 1 tab, 11 ref.

Descriptors: *Ultrafiltration, *Enteroviruses, Water quality, Groundwater, Organic compounds.

An ultrafiltration method for the recovery of enteric viruses from large volumes of water is described (it is an improvement of a process described earlier). An 8000-fold concentration was achieved inapproximately 3 h from a starting volume of 400 l. The final average poliovirus recovery was 21% (vs 0.06% unaided recovery). The method was unaffected by the presence of organic substances in the sample water. Although the apparatus is in a fixed location, use of a portable 450 l fiberglass tank allows collection of samples from various locations. The technique allows processing of samples at ambient pH, thus avoiding virus deactivation. (Airone-PTT)
W87-05921

5B. Sources Of Pollution

SALINITY IN WATERCOURSES AND RESERVOIRS.
For primary bibliographic entry see Field 5G.
W87-05165

PROBLEM OF SALINITY AND ITS CONTROL, RIVER MURRAY, AUSTRALIA,
River Murray Commission, Canberra (Australia).
For primary bibliographic entry see Field 5G.
W87-05168

DRAINAGE AND SALINITY CONTROL PROGRAMS IN PAKISTAN,
International Bank for Reconstruction and Development, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-05169

LEGAL AND INSTITUTIONAL CONSTRAINTS TO SALINITY CONTROL,
Bureau of Reclamation, Provo, UT. Utah Projects Office
For primary bibliographic entry see Field 5G.
W87-05170

SALINITY SOURCES AND PROBLEMS OF THE DANUBE RIVER BASIN,
North Dakota State Univ., Fargo. Dept. of Soil Science.
A. Maianu.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 105-114, 2 fig, 4 tab, 12 ref.

Descriptors: *Water pollution sources, *Danube River, *River basins, *Salinity, Water pollution effects, Water quality control, Saline soils, Irrigation practices, Romania, Hungary, Yugoslavia, Bulgaria.

In the process of salt accumulation in the Danube Basin, the human influence has been in the direction of increasing salinity in both groundwater and soil. In the 19th century, extensive flood control work was done on the Tisa River and its tributaries; 2.5 million ha of land were freed from permanent or temporary water flooding. These actions caused drastic soil salinization and alkalization, which makes the Great Hungarian Plain today the most extensive area of salt-affected soils in Europe. In the Danube Valley the work was started in the current century, on more than 1,000,000 ha, in Romania, Hungary, Yugoslavia and Bulgaria, with similar salinization effects. Extensive irrigation systems are currently being built in these countries using Danube water for irrigation. In Romania alone, over 1,000,000 ha are presently irrigated with Danube water. But in spite of good quality river water, the majority of the irrigated soils are in danger of secondary salinization. In all cases, the salt source is the groundwater. Using the Danube for irrigation and also as a drainage outlet for saline drainage water creates new salt problems. Cooperative international projects need to study the salt balance of surface and groundwaters in the Danube Basin. A coordinated use of irrigation waters and drainage waters is also needed in a river basin which serves eight countries. (See also W87-05165) (Lantz-PTT)
W87-05174

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI RIVER,
Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 5G.
W87-05175

NATURAL SALT POLLUTION CONTROL, BRAZOS RIVER BASIN, TEXAS,
Army Engineer District, Fort Worth, TX.
For primary bibliographic entry see Field 5G.
W87-05177

SALINITY BALANCE OF THE LOWER VIRGIN RIVER BASIN, NEVADA AND ARIZONA,
Montana Univ., Missoula. Dept. of Geology.
W. W. Woessner, M. D. Mifflin, R. H. French, A. Elzeftawy, and D. E. Zimmerman.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 145-156, 2 fig, 1 tab, 15 ref.

Descriptors: *Salinity, *Virgin River, *Nevada, *Arizona, River basins, Water pollution control, Path of pollutants, Saline water, Monitoring, Stream gages, Hydrologic budget, Dissolved solids.

This 12 month study developed additional hydrologic data for the development of salinity budgets in the Lower Virgin River Valley, Nevada and Arizona, a tributary of the Colorado River. Monthly stream gaging at six stations, groundwater monitoring at existing and new sites, water quality sampling and soil sampling were included. Results indicate a complex hydrologic system with concentration, storage, and transport of salt occurring in the study area. Water and salt budget analyses indicate a 36% net loss of water and a 34% net loss in salt for a 61 km reach of river. The majority of water loss is attributed to phreatophyte consumptive use. Salt concentrations associated with phreatophyte consumptive use exceeded consumptive concentration of salt by agriculture and direct evaporation by 2.6 times. Data indicate that phreatophyte areas play a major role in salt accumulation and storage by consumptively utilizing 2.1 to 3.6 m of water/yr. Total dissolved solids concentrations of 5,800 to 11,000 mg/L were measured in the shallow groundwater underlying phreatophyte areas. (See also W87-05165) (Author's abstract)
W87-05178

GRAND VALLEY SALT PICK-UP CALCULATIONS,
Bureau of Reclamation, Grand Junction, CO.
R. R. Inman, D. C. Olson, and D. L. King.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 157-167, 2 fig, 4 tab, 2 ref.

Descriptors: *Salinity, *Grand Valley, *Colorado, *Colorado River, *Pollution load, Fate of pollutants, Hydrologic budget, Salt loading, Saline water.

The Grand Valley in western Colorado is a significant contributor of salt loading in the Colorado River, which has an average salt load of 9,000 million kg/yr. This salt loading, was quantified based on an analysis of an inflow-outflow river budget, showing that a river budget can be used to estimate accurately the salt pickup. The mean annual salt pickup from the entire Grand Valley was about 528 million kg/yr, or 6% of the total average annual salt loading to the river. Although annual values fluctuate widely, there is a 95% confidence limit on the mean of + or - million kg/yr. No significant trend in salt pickup was found, indicating that the salt loading appears constant over 29 years of study data. (See also W87-05165) (Lantz-PTT)
W87-05179

IMPACT OF RESERVOIRS ON SEASONAL AND HISTORICAL SALINITY OF THE COLORADO RIVER,
Bureau of Reclamation, Salt Lake City, UT.
D. P. Trueman, and J. B. Miller.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 171-180, 4 fig, 3 tab, 9 ref.

Descriptors: *Salinity, *Colorado River, *Reservoirs, *Seasonal variation, History, Water storage, Fate of pollutants, Saline water, Pollution load, Water pollution control, Water quality control.

Reservoir storage in the Colorado River Basin has increased to 80 cu km in 1982. The retention time of the system has increased to the range of 4-6 years. This retention time has decreased both the seasonal and annual variability of salinity in the basin. The Colorado River is currently behaving as a mixed reactor system rather than the plug flow systems of its natural state. With the system operating at near capacity, water in excess of demands can no longer be stored by the system. This will increase the average discharge through the Colorado River by approximately 2.5 cu km/yr. This excess in flow will effectively dilute the salinity in the Lower Basin. Development in the Upper Basin will eventually reduce the flow through the system and cause an increase in salinity as depletions come online in the future. Until further development occurs, average or wet periods, combined with the reduced capacity to store excess amounts of water, will continue to keep salinity down and periodically cause salinity to drop as it did in 1980. (See also W87-05165) (Lantz-PTT)
W87-05180

HISTORICAL TRENDS IN CONCENTRATION AND LOAD OF MAJOR IONS IN THE COLORADO RIVER SYSTEM,
Water and Power Resources Service, Denver, CO.
D. K. Mueller, and C. D. Moody.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 181-192, 4 fig, 1 tab, 10 ref.

Descriptors: *History, *Ion concentration, *Colorado River, *Water pollution sources, Path of pollutants, Green River, San Juan River, Chlorides, Halite, Calcium sulfate, Gypsum, Irrigation effects, Data interpretation.

Headwaters of the Colorado and its major tributaries, the Green and San Juan Rivers, lie in the high peaks of the Rocky Mountains, where precipitation averages 100 to 150 cm/a. Most of its course, however, crosses the semiarid Colorado Plateau and the Sonoran Desert, where average annual precipitation may be as low as 6 cm. Many of the geologic formations in this part of the basin are of marine origin and contain sodium chloride (halite) and calcium sulfate (gypsum) salts. Natural springs or seeps and man-made wells intercept saline groundwaters associated with these formations and discharge into the river system. Soils in much of the basin have developed residually on gypsum-bearing shales. Irrigation water applied to this land promotes weathering and dissolution of salts from the soil and underlying shales and returns to the river with a greater salt load than was diverted. A method was developed to generate mean monthly discharge and concentration values and presents preliminary results of the trend analysis are presented. Significant mean value differences are easier to identify than trends. For 23 of the 27 possible combinations of solutes and monthly time periods shown, a significant change is indicated for at least one dependent variable (load, concentration, or mass fraction). Significant trends are identified for only 21 of 54 possible combinations, including both pre- and postdevelopment periods. Overall, the data base development procedure allows maximum use of existing data to determine reasonable estimates of monthly mean solute concentrations, loads, and mass fractions. Regression of seasonal values is a valuable technique for analysis of this generated data. Interpretation of regression results must consider the general observations listed previously. (See also W87-05165) (Lantz-PTT)
W87-05181

EFFECT OF ASSUMPTIONS ON MODEL CALIBRATION AND PREDICTION,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2A.
W87-05182

IMPROVING MANAGEMENT PRACTICES ON SURFACE IRRIGATED LANDS: THE ROLE OF MODELING,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 5G.
W87-05183

LONGITUDINAL-VERTICAL HYDRODYNAMICS AND TRANSPORT WITH CHEMICAL EQUILIBRIA FOR LAKE POWELL AND LAKE MEAD,
Edinger (J.E.) Associates, Inc., Wayne, PA.
J. E. Edinger, E. M. Buchak, and D. H. Merritt.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 213-222, 5 fig, 1 tab, 6 ref.

Descriptors: *Hydrodynamics, *Water chemistry, *Chemical equilibria, *Lake Powell, *Lake Mead, Hydrologic models, Calcium carbonate, Sulfates, Temporal distribution, Spatial distribution, Chemical precipitation, Gypsum, Chemical analysis, Reservoirs, Simulation analysis.

Versions of the LARM longitudinal and vertical hydrodynamic and transport model have been set up to study the time-varying seasonal circulation, heat and salinity transport of Lake Powell and Lake Mead. The model has been coupled with the calcium carbonate and sulfate equilibria to determine the temporal and spatial distribution, as well as the amount, of the precipitation of calcium carbonate. Lake Mead data show that there are gypsum or CaSO4 sources along the reservoir that can add calcium and sulfate to the system and shift the carbonate balance. This is accomodated in the chemical balance by transporting sulfates along with calcium, inorganic carbon and net charge. For Lake Mead, the sulfate is removed from the definition of net charge since it is no longer conservative and is included in the charge balance, for computation of the equilibria and CaCO3 saturation. By modeling the equilibrium relations over the entire volume of the reservoir, the change in concentration due to precipitation and dissolution over a year or more can be evaluated. Simulations at different reservoir levels, and inflow and outflow conditions will enable determination of their effects on changes in total dissolved solids. The results can then be included in the Colorado River Simulation System, providing another improvement in the predictive techniques. (See also W87-05165) (Lantz-PTT)
W87-05184

CONCEPTUAL MODELS OF GEOLOGIC AND AGRICULTURAL SALT LOADS IN STREAMS OF THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
C. J. Duffy.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 223-233, 4 fig, 5 ref.

Descriptors: *Model studies, *Geochemistry, *Colorado River, *Water pollution sources, Alluvium, Salinity, Irrigation effects, Soil chemistry, Chemical analysis, Solute transport, Groundwater movement.

The interior region of the Upper Colorado River Basin is an area chiefly comprised of flat lying or gently dipping Mesozoic and Paleozoic sediments of continental to marine origin. Unconsolidated material consists of alluvium transported from adjacent uplands and locally produced residuum, which forms a thin veneer on the erosional surface of underlying strata. It is generally held that downstream salinity increases are caused by two predominant factors: (1) salt concentrating processes, such as evaporation and consumptive use by irrigated crops and native vegetation and, (2) salt loading processes which result from dissolution and weathering of residual salts from soil and geologic strata by infiltration of excess irrigation water and natural recharge. Reported is a preliminary effort to examine some specific aspects of the interaction and mixing of groundwaters from near surface saline strata and infiltration of water and solutes from irrigated agriculture. The research is divided into two components: (1) Stream salinity from processes occurring within the alluvium, which includes effects of residence time, and salt dissolution from partially weathered residuum and alluvium, and (2) Stream salinity originating from underlying low permeable formations (bedrock) transported vertically across the bedrock contact into the overlying alluvium by diffusion mechanisms. It is shown that the long term source potential of underlying sedimentary rocks may be significant even in cases where the rocks have relatively low permeability and salt transport is essentially by upward diffusion. If it also demonstrated that overirrigation and excess deep percolation tend to accelerate the chemical weathering of the underlying strata, and thus irrigation efficiency plays an important role in the salinity production from these strata. (See also W87-05165) (Lantz-PTT)
W87-05185

CASE STUDY OF A SALINITY CONTROL PROGRAM, UINTA BASIN, UTAH,
Soil Conservation Service, Salt Lake City, UT.
For primary bibliographic entry see Field 5G.
W87-05190

CASE STUDY OF A MAJOR AGRICULTURAL CONTROL PROGRAM - THE GRAND VALLEY EXPERIENCE,
Soil Conservation Service, Denver, CO.
For primary bibliographic entry see Field 5G.
W87-05191

GRAND VALLEY STAGE ONE MONITORING PLAN AND IMPLEMENTATION,

Bureau of Reclamation, Grand Junction, CO.
For primary bibliographic entry see Field 5G.
W87-05192

CONTROLLING SALINITY IN THE COLORADO RIVER BASIN, THE ARID WEST,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
For primary bibliographic entry see Field 5G.
W87-05196

SALINITY CONTROL BY PUMPING AND DEEP WELL INJECTION - THE PARADOX VALLEY UNIT,
Bureau of Reclamation, Durango, CO.
For primary bibliographic entry see Field 5G.
W87-05197

MEEKER DOME SALINITY INVESTIGATION,
CH2M/Hill, Denver, CO.
C. F. Feast.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 359-365, 3 fig, 1 tab, 3 ref.

Descriptors: *Meeker Dome, *White River, *Colorado, *Salinity, *Water pollution sources, *Data acquisition, Salt, Saline water, Oil wells, Brines, Chemical analysis, Data collections, Plugging, Water level, River flow, Aquifers, Groundwater pollution.

The Meeker Dome Unit was included in the Colorado River Water Quality Improvement Program (CRWQIP) because up to 54-million kg/yr of salt was being added to the Colorado River system from saline springs that began appearing several years after plugging of the Meeker Well, an abandoned oil test well at the base of the Meeker Dome along the White River in northwestern Colorado. The Meeker Dome is a topographic and geologic dome with gently dipping flanks. The White River has eroded the south flank forming steep slopes and cliffs; the top of the Dome is about 95 m above the river. Immediately following cementing, water levels in the upper Morrison aquifer began falling rapidly. Water levels and spring flows have declined continuously since final plugging, although the rates of decline have slowed down as the Morrison aquifer drains by gravity. As a measure of the effectiveness of oil well reentry and plugging, salt loading trends of the White River were studied using river flow and water chemistry data collected by the U.S. Geological Survey in cooperation with the Bureau of Reclamation. This large data base allowed close approximation of the salt loading occurring along the Meeker Dome. Immediately prior to plugging, salt loading was at a rate of approximately 24-million kg/yr. At the end of the first year following plugging, that rate had dropped to less than 4.5-million kg/yr and was still falling. This represents about an 80% decrease in salt loading over this period. The well-related flow mechanism was confirmed, and the investigation activities appear to have eliminated the source of salt loading. (See also W87-05165) (Lantz-PTT)
W87-05198

GLENWOOD-DOTSERO SPRINGS SALINITY CONTROL PROJECT,
URS Co., Denver, CO.
For primary bibliographic entry see Field 5G.
W87-05201

PRICE/SAN RAFAEL RIVER BASINS SALINITY INVESTIGATION,
CH2M/Hill, Boise, ID.
For primary bibliographic entry see Field 5G.
W87-05203

STUDY OF SALINITY PRODUCTION FROM WILDLANDS OF PRICE RIVER BASIN, UTAH,
Unitex Corp., Salt Lake City, UT.
A. Lin.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 417-426, 4 fig, 3 tab, 6 ref.

Descriptors: *Salinity, *Water pollution sources, *Price River, *Utah, Erosion, Sedimentation, Saline water, Overland flow, Mathematical studies, Universal Soil Loss Equation, Shale, Soil erosion, Rainfall, Snowmelt.

The importance of hillslope erosion in sediment and salinity production of the Price River Basin, Utah is confirmed. In investigating hillslope erosion processes, it is necessary to consider (1) the difference between the 'first event' and the others in a running sequence, and (2) the separation of mass wasting, if it exists, from overland flow processes. The Universal Soil Loss Equation (USLE) could be useful in western wildland if the coverage factor is properly calibrated. Additionally, to use USLE effectively for individual events, should be applied to runoff source areas. In-channel solute pick-up could be important where Mancos Shale is exposed. For a fixed amount of exposure of Mancos Shale in a watershed, there should be an upper limit for the salt encrustation along the exposed part. It is postulated that given sufficient time for salt crust to mature, the amount of in-channel solute pick-up for a 'first event' is more or less a fixed quantity. Thunderstorms in the summer and fall produce an estimated 11% of total salt load in the basin. There is no data to assess salt production generated from erosion associated with spring snowmelt runoff. (See also W87-05165) (Lantz-PTT)
W87-05204

GEOCHEMICAL IDENTIFICATION OF SALINITY SOURCES,
Kansas State Geological Survey, Lawrence.
D. O. Whittemore.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 505-514, 5 fig, 14 ref.

Descriptors: *Chemical analysis, *Water pollution sources, *Geochemistry, *Saline water, *Salinity, Iodine, Chlorine, Strontium, Radioisotopes, Boron, Lithium, Deuterium, Kansas, Carbon radioisotopes, Smoky Hill River, Great Bend Prairie, Equus Beds, Blood Orchard Area.

Minor dissolved constituents are valuable for characterizing saline waters in certain areas. Relationships of I-Cl and I-Sr have been found to be indicative of different types of saline groundwaters. Bromide concentrations have been used to explain the origin of brines in sedimentary rocks. Ratios of B/Cl and Li/Cl range widely in brines and thus have been of value in identifying salinity sources. Application problems of minor constituents include concentration changes by adsorption and precipitation during subsurface flow. The environmental isotopes 14-C, 18-O, deuterium, and tritium have been used to characterize saline waters in arid basins. However, the application of isotopes to saline systems is limited by problems with evaporation-precipitation relationships, narrow ranges in some values, and the generally greater expense and time required for analyses. The use of Br/Cl and I/Cl ratios has improved the discrimination of saltwater sources in Kansas. Values of Br/Cl and I/Cl are much higher in very freshwaters and oil-field brines than in halite-solution brines. The identification of salinity sources in Kansas from graphs of Br/Cl versus Cl concentration and zones of mixing of different waters is presented in this paper. Similar results have been obtained using I/Cl, but the Br/Cl method is preferred because Br is more conservative and samples do not require refrigeration as for I if analyzed within a few weeks after collection. Four case histories are used to illustrate the use of these methods for identifying salinity sources in Kansas (Smoky Hill River Valley, Great Bend Prairie, Equus Beds, and Blood Orchard Area). (See also W87-05165) (Lantz-PTT)
W87-05212

DETECTION OF SUBSURFACE SALINITY WITHIN THE NORTHERN SLOPES REGION OF VICTORIA, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
B. G. Williams, and M. Braunach.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 515-524, 4 fig, 1 tab, 12 ref.

Descriptors: *Groundwater quality, *Saline water, *Water pollution sources, *Victoria, *Australia, Groundwater level, Salinity, Electromagnetic waves, Geochemistry.

Much is known of the geomorphic and cultural factors that can result in the rise of groundwaters but rather less is known of how to detect subsurface saline material and groundwater. Such information would permit the implementation of land-use srategies designed to avoid secondary salinization and thus reduce the cost of post-damage amelioration. Exploration drilling, although providing the detailed information ultimately required, is slow and expensive. More rapid, indirect methods are required to detect and monitor areas of potential salinization, particularly where the problem is of a regional scale. Electromagnetic induction (EM) is proving to be one such that has produced useful results for areas ranging from field size to regions of 10,000 sq km. Described here is the application of the EM technique to an exploratory transect across the lower Northern Slopes area of Victoria. The survey indicates the magnitude of potential secondary salinization in that region. It also indicates the inherent variability in the distribution of saline materials within the major geologic formations. The relatively coarse sampling frequency (5 km) does not permit detailed speculation of problems and possible controls but it does indicate that approximately 300 km of that 500 km transect have a potential for secondary salinization should the groundwater system be conducive to the mobilization and transport of soluble salts. Although no detailed profile descriptions were possible from the electrical conductivity (ECa) values obtained, the multi-frequency facility of the EM34/3 instrument gives some indication of the relative contributions of the upper and lower parts of the profile. Conversion of ECa values to soil salinity units is still dependent on calibration measurements from borehole samples. However comparisons of the relative apparent conductivities are of considerable value in determining where more expensive, detailed investigations should be located. (See also W87-05165) (Lantz-PTT)
W87-05213

CHEMICAL REACTIONS INFLUENCING SALINITY INCREASE OF SOIL AND GROUNDWATERS IN THE GREAT BASIN, WESTERN UNITED STATES,
Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 2K.
W87-05214

ANALYSIS OF SALT YIELDS ASSOCIATED WITH THE CONSTRUCTION AND OPERATION OF PARIETTE DRAW WILDLIFE AREA, UTAH,
Bureau of Land Management, Lakewood, CO. Denver Service Center.
W. L. Jackson, and S. Hudson.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 549-558, 5 fig, 1 tab, 3 ref.

Descriptors: *Salts, *Chemical analysis, *Water pollution sources, *Pariette Draw, *Utah, Saline

water, Water analysis, Data acquisition, Data interpretation, Statistical analysis, Management planning.

A 50% increase in annual salt yield has been recorded at the downstream (7300) gage at Pariette Draw, near Ouray, Utah, following the beginning of construction of the Pariette Draw Wildlife Management Area. This increase occurred during a period when there was a much smaller (11%) increase in salt yield at the upstream (7200) station. However, analysis of water discharge data and station salt-loading functions (Q vs. TDS) indicate that 94% of the increase in annual salt yield at the downstream station is due to the increase in mean monthly flow following the beginning of construction of the wildlife management area, and 6% of the increase is due to a small though statistically significant (alpha=0.05) change in the salt loading function (Q vs.TDS) at the downstream station. It is hypothesized that increased inflows from Castle Peak tributary caused downstream flows during the post-construction period to increase proportionally more than flows entering the area upstream. Based on the analysis of the existing data at Pariette Draw, it s believed that a 300 ha expansion of the wildlife management are will result in a maximum increase of approximately 540 to 630 mg of salt/yr in the Colorado River (based upon an increase of 1.97 mg/ha/yr at the existing wildlife area). Approximately 7,700,000 cu m/yr of water can be expected to be consumed by the wildlife management area. (See also W87-05165) (Lantz-PTT)
W87-05216

SECONDARY SALINIZATION OF WATER RESOURCES IN SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma, and D. R. Williamson.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 571-580, 3 fig, 2 tab, 22 ref.

Descriptors: *Salinity, *Saline water, *Australia, *Water pollution sources, Water quality control, Eucalyptus, Salinization, Dryland agriculture, Evapotranspiration, Groundwater recharge, Path of pollutants, Legal aspects, Water management, Stream diacharge.

About 4.9 times 10 to the 9th cu m/yr of surface water resouces in southern Australia have solute concentrations in excess of 1,000 mg/L. This secondary salinization is a consequence of the clearing of indigenous Eucalyptus vegetation for development of dryland agriculture. Because of reduced evapotranspiration from crops and pasture there is excess water available to mobilize the large mass of salts stored in the deep profiles. The current understanding of the various mechanisms involved are reviewed; evapotranspiration and groundwater recharge, and transport of solute and water. There is no established method for the reclamation of secondary salinity in Australian dryland agriculture. Revegetation of saline seeps using halophytes has been used as a management approach but has not been shown to reclaim the land nor reduce salt input to streams. The control of clearing by legal statute has been applied to five catchments in south-west Western Australia, and to one catchment in Victoria. Leaving sufficient trees to utilize excess recharge is an option being researched. Approximate water balance calculations suggest that only a small portion (10-25%) of the original vegetation needs to be left uncleared or replanted. An engineering approach to water quality management involves intercepting saline streamflow and diverting it around the main storage reservoir. Standard drainage techniques have been tested for dewatering saline seeps, but cost and maintenance problems prevent general use. Limited success has been claimed by some farmers with a method in which lateral flow is intercepted by impervious banks cut into the clayey subsoil. All drainage methods are likely to have limited effectiveness in preventing stream salinity due to the difficulty of disposal of saline effluent. (See also W87-05165) (Lantz-PTT)
W87-05218

POTENTIAL GROUNDWATER IMPLICATIONS OF LAND DISPOSAL OF TOXIC SUBSTANCES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5E.
W87-05245

UTILIZATION OF SALT DOMES FOR CHEMICAL-WASTE DISPOSAL,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 5E.
W87-05247

GROUNDWATER MONITORING, CONTROL, AND ANALYSIS,
Underground Resource Management, Inc., Austin, TX.
R. Kent, D. McMurtry, and M. Bentley.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 461-487, 16 fig, 3 tab.

Descriptors: *Groundwater pollution, *Monitoring, *Water quality control, *Path of pollutants, Waste disposal, Disposal sites, Fate of pollutants.

There are a variety of investigative techniques available to study groundwater systems at waste sites. One frequently used technique is the installation and periodic sampling of monitoring wells. Too frequently, industry, consultants, and government fail to understand the complexity of waste migration. Before monitor wells are installed, the waste migration process should be understood. Working hypotheses should be developed and monitor wells should be carefully designed. Contrary to popular belief, there is no single, correct way to install monitor wells. Methods that are correct in one situation may not yield usable information in another. If all factors in the design, location, and installation of monitor wells could be assigned numerical values that in sum would equal 100, then it is probable that not one installation could reach that total value. The best one can probably do is achieve 85 or 90. Therefore, all data from monitor wells must be evaluated with a full understanding of the limitations of the installation, sampling, and analytical techniques in order to understand the subsurface flow systems. (See also W87-05219) (Lantz-PTT)
W87-05248

HYDROELECTRIC OPERATION AT THE RIVER BASIN LEVEL: RESEARCH NEEDS TO INCLUDE ECOLOGICAL ISSUES IN BASIN-LEVEL HYDROPOWER PLANNING.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 6G.
W87-05250

TWO-WELL RECIRCULATION TRACER TESTS AT THE H-2 HYDROPAD, WASTE ISOLATION PILOT PLANT (WIPP), SOUTHEASTERN NEW MEXICO.
Hydro Geo Chem, Inc., Tucson, AZ.
Contractor Report SAND86-7092, October 1986. DOE Contract DE-AC04-76DP00789. 33 p, 11 fig, 24 ref, 2 append.

Descriptors: *Tracer studies, *Recirculation, *Test wells, *Kinematic porosity, *Dispersivity, *Culebra dolomite, *New Mexico, *Path of pollutants, *Waste treatment, Tracers, Dolomite, Halomethane, Pentafluorobenzoate, Sodium thiocyanate, Difluorochlorobromoethane, Fate of pollutants, Porosity, Dispersity.

Two recirculation tracer tests were performed on the Culebra Dolomite Member of the Rustler Formation at the H-2 hydropad at the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. The first test, which used pentafluorobenzoate (PFB), sodium benzoate, and a suite of halocarbons for tracers, was terminated before breakthrough at the pumping well because of equipment failure. The second test, which used sodium thiocyanate (SCN) and difluorochlorobromoethane (BCF) as tracers, proceeded normally and lasted 270 days. During the second test, the tracer injected during the first test was recovered. Tracer test analyses for the two tests were performed only for the PFB tracer injected during the first test and recovered during the second, and for SCN. Analysis of the PFB recovery was crudely modeled as a one dimensional pulse-injection test. The SCN tracer used in the second test was analyzed with the homogeneous, isotropic Grove and Beetem one dimensional, porous-medium, recirculating flow test model. In general, model predictions are in poor agreement with the field measurements. Discrepancies could be produced by the combined effects of local nonhomogeneities, matrix diffusion, and possible sorption or degradation of the tracer during the test. The best overall match between the SCN breakthrough curve, predicted by the semianalytical model and that observed in the measurements, was acheived using a porosity that ranged from 17% to 19%, and a dispersivity of 16 to 18 feet. A match based only on the early part of the breakthrough curve, however, yielded a porosity of 11.5% and a dispersivity of 8 feet. The latter porosity might more closely represent the effective porosity of the Culebra, if the SCN degraded during the test. Modeling of test results on the assumption that the Culebra Dolomite behaves as an isotropic porous medium is described. (Author's abstract)
W87-05254

SELENIUM IN WESTERN ATLANTIC PRECIPITATION,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. A. Cutter, and T. M. Church.
Nature NATUAS, Vol. 322, No. 6081, p 720-722, August 1986. 2 fig 1 tab, 24 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Selenium, *Precipitation, *Atlantic Ocean, *Deposition, Oxidation, Trace elements, Tracers, Marine environments, Power plants, Fuel, Transport.

Selenium's mobilization by fossil fuel combustion and selenium's toxicity provide compelling reasons to examine this element's atmospheric transport and removal. Recent investigations suggest that atmospheric deposition is an important selenium input to oceanic surface waters. Data on the concentration and oxidation state of selenium in precipitation over coastal and mid-ocean regions of the Atlantic Ocean are examined. Results indicate that fossil fuel combustion enriches selenium in wet depositional fluxes to western Atlantic surface waters, and that selenium's oxidation state in precipitation may be a sensitive oxidation-reduction (redox) tracer. (Author's abstract)
W87-05257

CORRELATIONS BETWEEN STREAM SULPHATE AND REGIONAL SO2 EMISSIONS,
Geological Survey, Reston, VA.
R. A. Smith, and R. B. Alexander.
Nature NATUAS, Vol. 322, No. 6081, p 722-724, August 1986. 2 fig, 2 tab, 19 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Sulfur dioxide, *Sulfates, *Acid streams, *Deposition, *Precipitation, *Regional analysis, *Acid rain, Acid soils, Data collections, Data acquisition, Sulfur.

The relationship between atmospheric SO2 emission and stream and lake acidification has been difficult to quantify largely because of the limitations of sulfur deposition measurements. Precipitation sulfate records are generally less than five years in length and do not account for dry deposition. A variable fraction of wet and dry deposited sulfur is retained in soils and vegetation and does

not contribute to the acidity of aquatic systems. Annual SO2 emissions for the eastern U.S. between 1967 and 1980 were compared with stream SO4 measurements from 15 predominantly undeveloped watersheds. Two forms of sulfur were strongly correlated on a regional basis. Streams in the southeastern U.S. received a smaller fraction (16% compared with 24%) of regional sulfur emissions than did streams in the northeast. In addition to providing direct empirical evidence of a relationship between sulfur emissions and aquatic chemistry, these results suggest that there are significant regional differences in the fraction of deposited sulfur retained in basin soils and vegetation. (Author's abstract)
W87-05258

FUTURE OF TURFGRASS MANAGEMENT AND UNDERGROUND WATER QUALITY,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
T. L. Watschke.
USGA Green Section Record, Vol. 24, No. 5, p 6-7, September-October 1986.

Descriptors: *Turf grasses, *Water pollution sources, *Path of pollutants, *Groundwater runoff, *Pesticides, *Runoff rates, Fertilizers, Groundwater management, Velocity, Percolation.

Little is known about the quality of runoff from grassed areas in urban-suburban watersheds. A water quality research center assessed the effects of turf grass stands on the quantity and percolation of runoff water. Different establishment methods were used for installation of turf on 12 slopes. Runoff water was intercepted and directed through a splitting device that provided subsamples for analysis and proportioned the remainder to a collection tank where data on flow rate from each slope was logged and total runoff was calculated. The runoff rate from seeded plots sometimes exceeded by 15 times the amount from sodded plots. This difference increased with time because of thatch under sodded plots and and increased density of the surface stand. Compared with thin, poor quality turf, dense, high quality turf having some thatch seemed to substantially reduce the velocity of runoff. As poorer quality turf improves from the use of fertilizers and pesticides, the rate of runoff should continually decline. Initial hydrological information on high quality turf appears to be very positive and should be useful to civil engineers as they design storm water collection systems. (Michael-PTT)
W87-05271

INTERACTIONS OF PESTICIDES WITH FRESH-WATER ALGAE: 1. EFFECT OF METHOMYL AND ITS POSSIBLE DEGRADATION BY PHORMIDIUM FRAGILE,
Cairo Univ., Giza (Egypt). Dept. of Botany.
Z. Khalil, and I. Y. Mostafa.
Journal of Environmental Science and Health JPFCD2, Vol. B21, No. 4, p 289-201, August 1986. 2 fig, 3 tab, 20 ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Cyanophyta, *Algal growth, *Freshwater algae, *Methomyl, *Degradation, *Fate of pollutants, Pesticides, Nitrogen, Carbohydrates, Chlorophyll, Carotene, Phosphorus, Carbon radioisotopes, Chloroform, Thin layer chromatography, Cultures, Metabolism, Insecticides.

The fate of the insecticide methomyl as affected by the blue-green algae Phormidium fragile was investigated. Experimental cultures were prepared to which different amounts of pure methomyl were added. After seven days, the culture mass was separated and three replicates from each treatment were placed in a hot air oven to determine changes in dry weight. Methomyl showed no significant effect on algal growth up to a concentration of 112.5 parts per million. However, inhibition was observed at higher concentrations. Biochemical analysis showed a gradual decrease in all nitrogen fractions, total carbohydrate content, chlorophyll a and carotene content. A considerable decrease in the amount of both soluble and insoluble phosphorus fractions was also observed. The organism was capable of degrading 48.6% of the applied radiolabelled insecticide of which only 0.1% of 14 carbon activity was trapped as 14 CO2. The chloroform and aqueous fractions contained 50.4% and 35.0%, respectively of the initial radioactivity. Thin layer chromatographic analysis showed the presence of three metabolites of methomyl, one of which was identified as the oxime. (Author's abstract)
W87-05276

NITROGEN FIXATION IN AN OLIGOTROPHIC, SALINE DESERT LAKE: PYRAMID LAKE, NEVADA,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
For primary bibliographic entry see Field 2H.
W87-05304

HORIZONTAL HETEROGENEITY OF NITROGEN FIXATION IN LAKE VALENCIA, VENEZUELA,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2H.
W87-05305

EUTROPHICATION AND THE RATE OF DENITRIFICATION AND N2O PRODUCTION IN COASTAL MARINE SEDIMENTS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W87-05306

ACIDITY OF DEW,
Ford Motor Co., Dearborn, MI.
W. R. Pierson, W. W. Brachaczek, R. A. Gorse, S. M. Japar, and J. M. Norbeck.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 3, p 4083-4096, March 1986. 6 fig, 7 tab, 67 ref.

Descriptors: *Water pollution sources, *Water analysis, *Chemistry of precipitation, *Acidic water, *Chemical properties, *Dew, *Acid rain, *Condensation, Rainfall, Fog, Water properties, Distribution, Diurnal distribution, Seasonal distribution, Sulfates, Nitrites, Solutes, Deposition, Acids, Acidity.

Nightly dew samples were collected on Allegheny Mountain (Pennsylvania) in August 1983. The dew was acidic, with mean pH about 4.0. Free H(+) comprised > 80% of the total acidity, and the composition approximated an H2SO4/HNO3 mixture with average SO4(2-)/NO3(-) mol ratio about 1.3. The chemistry of the dew resembled that of rain at Allegheny, though the dew was generally more dilute. The most acidic dews were associated with wind from the west. Average deposition velocities to dew were measured for HNO3, NO2, SO2, and various aerosol species. Comparison of the HNO3 deposition velocity with 10-fold higher summer daytime values reveals a pronounced diurnal variation. The 0.24 cm/s value for HNO3 may represent a maximum for any gas or submicron aerosol species whenever the atmosphere is strongly stable. Not all of the S(IV) in dew had been converted to sulfate by morning; thus, the rate of oxidation must have been on a time scale of hours at nighttime ambient temperatures. In contrast, S(IV) in rain and fog samples was not evident. Deposition fluxes and cumulative deposition totals involving dew, rain, and settled fog water were compared. Rain proved by far the most important for deposition of all solute species, including acid. (Author's abstract)
W87-05340

POSSIBLE ROLE OF NO3 IN THE NIGHTTIME CHEMISTRY OF A CLOUD,
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
W. L. Chameides.
Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 5, p 5331-5337, April 1986. 3 fig, 3 tab, 36 ref. NASA Grant NAG-1-85; NSF Grant ATM-8208828.

Descriptors: *Water pollution sources, *Acid rain, *Nitrates, *Clouds, *Chemical properties, *Chemical reactions, Chemistry, Water properties, Sulfates, Chlorides, Kinetics, Sulfuric acid, Solubility, Oxidation, Equations.

Calculations simulating the chemistry of a cloud indicate that not only can the nighttime chemistry of NO x in clouds result in the generation of nitric acid, but it can also lead to the production of sulfuric acid. The production of both acids is preceded by the generation of gas-phase NO3 from the reaction of NO2 with O3, followed by droplet scavenging. Once in the aqueous phase, NO3 is rapidly converted to the stable NO3(-) ion by a variety of reactions with other species dissolved in cloud water, thereby leading to nitric acid generation. The production of sulfuric acid is triggered by the reactions of NO3 and other radicals produced from NO3 with HSO3(-), the latter arising from the dissolution of gaseous SO2. The nighttime production of dissolved nitrate from NO3 will not be significant in clouds wherever gas-phase concentrations of nitric acid are larger than that of NO x. However, calculations indicate that in regions where NO x is higher, the dissolution and conversion of NO3 can lead to nitrate levels in cloud water significantly higher than what would be obtained from dissolution of nitric acid alone. (Author's abstract)
W87-05341

EXTRACTION AND PURIFICATION OF TOXIC PEPTIDES FROM NATURAL BLOOMS AND LABORATORY ISOLATES OF THE CYANOBACTERIUM MICROCYSTIS AERUGINOSA,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W87-05349

GROWTH OF THERMOPHILIC OBLIGATELY AUTOTROPHIC HYDROGEN-OXIDIZING BACTERIA ON THIOSULFATE,
Iceland Univ., Reykjavik. Biological Inst.
For primary bibliographic entry see Field 2H.
W87-05350

LONG-RANGE TRANSPORT AND DEPOSITION OF ACIDIC NITROGEN SPECIES IN NORTH-WEST EUROPE,
UKAEA Atomic Energy Research Establishment, Harwell (England). Modelling and Assessments Group.
R. G. Derwent, and K. Nodop.
Nature NATUAS, Vol. 324, No. 6095, p 356-358, November 1986. 3 fig, 1 tab, 14 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Europe, *Path of pollutants, *Deposition, *Model studies, *Nitrates, *Acid rain, *Rainfall, Nitrogen, Aerosols, Air pollution, Nitrogen compounds, Nitrogen cycle, Distribution, Spatial distribution, Sulfur, Ammonium compounds, Chemistry, Ammonia, Ozone, Transport.

A simple model is presented that can account for much of the nitrate in rain observed over northwest Europe. The life cycle of acidic nitrogen compounds potentially involves a wide range of trace constituents, including NO, NO2, gaseous HNO3, higher nitrogen oxides, nitrate aerosol, and nitrate in precipitation. The model incorporates an assumed life cycle of nitrogen-containing trace gases and the known NO sources. A high degree of correlation was observed between model calculations and observations of nitrate in precipitation at 25 sites. The slopes are significantly different among the various model experiments and approach unity only when the ammonia and nighttime chemistry is introduced. Intercepts are not significantly different from zero, indicating apparent absence of background contribution to nitrate in precipitation. It is concluded that future trends in wet nitrate deposition may depend not only on nitrogen oxide emissions but also on NH3 and ozone concentrations and their changes. (Doria-PTT)

W87-05352

PARASITE-DERIVED HAZARDS FOR CATTLE, SWINE AND POULTRY FROM WATER USED FOR DRINKING AND CLEANING PURPOSES (PARASITENBEDINGTE RISIKEN FUR RINDER, SCHWEINE UND HUHNER DURCH TRANK- UND BRAUCHWASSER),
Giessen Univ. (Germany, F.R.). Inst. fuer Parasitologie.
For primary bibliographic entry see Field 5F.
W87-05374

STATE AND FEDERAL LAND USE REGULATION: AN APPLICATION TO GROUNDWATER AND NONPOINT SOURCE POLLUTION CONTROL,
For primary bibliographic entry see Field 5G.
W87-05382

CADMIUM- AND MERCURY-RESISTANT BACILLUS STRAINS FROM A SALT MARSH AND FROM BOSTON HARBOR,
Brandeis Univ., Waltham, MA. Rosenstiel Basic Medical Sciences Research Center.
For primary bibliographic entry see Field 5C.
W87-05395

PRODUCTION AND TURNOVER OF PLANKTONIC BACTERIA IN TWO SOUTHEASTERN BLACKWATER RIVERS,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W87-05397

MEASUREMENTS OF THE CHEMICAL COMPOSITION OF CLOUDWATER AT A CLEAN AIR SITE IN CENTRAL SCANDINAVIA,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 5A.
W87-05405

RELATIVE CONTRIBUTIONS OF TROPOSPHERIC AND STRATOSPHERIC SOURCES TO NITRATE IN ANTARCTIC SNOW,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
M. R. Legrand, and R. J. Delmas.
Tellus TELLAL, Vol. 38B, No. 3/4, p 236-249, July-September 1986. 8 fig, 2 tab, 46 ref.

Descriptors: *Water pollution sources, *Antarctic snow, *Nitrates, *Pollutant identification, *Atmospheric chemistry, *Troposphere, *Stratosphere, Ice sheet, Ice cores, Snow, Deposition, Firn, Spatial variation, Temporal variation, Ions, Antarctica.

In recent years, much attention has been focused on the atmospheric nitrogen cycle, the second major biogenic cycle. In comparison to the sulfur cycle, the nitrogen cycle is more complicated, since it comprises multiple compounds which are capable of participating in numerous reactions in stratospheric and tropospheric chemistry. The nitrate contents of nearly 500 firn samples collected at various sites on the Antarctic ice sheet are reported. Additional chemical measurements of all major ions, in particular protons, have also been performed so that new conclusions regarding the most probable form and origin of nitrate in the Antarctic can now be drawn. It is shown that nitrate is deposited as gaseous HNO3 and that tropospheric sources dominate in this remote region. Continental and anthropogenic nitrates are not significant contributors. It is suggested that lightning at tropical and/or mid latitudes is the most likely source of Antarctic nitrate. The formation of HNO3 (or its precursors) in the stratosphere is discussed and the possible evidence for this contribution in several profiles is carefully investigated. The absence of a convincing correlation between solar factors and nitrate concentrations in snow confirms that past solar activity fluctuations cannot be reconstructed from polar ice cores. The spatial and temporal variations observed in this study are, however, not fully explained. Finally, emphasis is placed on the necessity of undertaking HNO3 measurements in the Antarctic atmosphere in order to elucidate the deposition mechanism of this major component of atmospheric chemistry. (Alexander-PTT)
W87-05406

REMOVAL OF SOLUBLE SPECIES BY WARM STRATIFORM CLOUDS,
Georgia Inst. of Tech., Atlanta. School of Physical Sciences.
Y. Qin, and W. L. Chameides.
Tellus TELLAL, Vol. 38B, No. 3/4, p 285-299, July-September 1986. 10 fig, 1 tab, 25 ref. NASA Grant NAG-1-85 and NSF Grant ATM-8208828.

Descriptors: *Mathematical models, *Model studies, *Stratiform clouds, *Path of pollutants, *Cloudwater, *Rainfall, Rainout, Transport, Turbulence, Clouds, Updrafts, Simulation.

Because of the high levels of condensed water typically found in clouds, they represent a unique chemical environment in the atmosphere. When an air mass is entrained into a cloud, the soluble species are rapidly separated from the insoluble ones and dissolved in the liquid water drops, contained in the cloud. Removal of these soluble species from the atmosphere via rainout occurs when the water containing dissolved constituents falls out of the cloud as raindrops and collects on the earth's surface. A one-dimensional, time-dependent model was developed to study the removal of soluble gases from a warm, precipitating stratiform cloud. The model calculates the distributions of water vapor and condensed water, in the form of cloud drops and raindrops, as well as the incloud concentration of a soluble species in the gas and aqueous phases for a specified profile of pressure and temperature and an assumed updraft velocity. Highly soluble gases are found to be rapidly dissolved into cloud droplets and then slowly incorporated into raindrops as cloudwater is converted to rainwater. As this rainwater begins to fall out of the cloud, the total in-cloud abundance of highly soluble species rapidly decreases, causing the rate of removal of the species from the cloud to also decrease. The rate of removal of highly soluble species continues to decrease until a balance between loss via rainout and transport of new material into the cloud is reached, and an approximate steady state is established. Thus the rainout rate for highly soluble species is found to be ultimately limited by the rate at which new gaseous material can be transferred from the cloud-free air into the cloud. The model calculations indicate that turbulence represents an important mechanism by which highly soluble gases are transported into stratiform clouds and thus the calculated rate of removal of highly soluble species from these types of clouds is dependent on the parameterization chosen to simulate this process. (Alexander-PTT)
W87-05407

COMPOSITION, DISTRIBUTION AND NEUTRALIZATION OF ACID RAIN DERIVED FROM MASAYA VOLCANO, NICARAGUA,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
N. Johnson, and R. A. Parnell.
Tellus TELLAL, Vol. 38B, No. 2, p 106-117, April 1986. 7 fig, 3 tab, 25 ref. NSF Grants EAR-8025719 and 80LAJR-3.

Descriptors: *Path of pollutants, *Acid rain, *Water pollution effects, *Masaya Volcano, *Neutralization, *Volcanoes, Volcanic acids, Vegetation, Shrubs, Soil properties, Water analysis.

The Santiago vent of Volcan Masaya has been erupting copious amounts of gas since 1979. The current activity represents only the latest episode in a series of such eruptions, and has exceeded 1,000 tons per day discharge of SO2. Acid rain (pH 2.5-5.0) from the volcanic plume of Masaya Caldera, Nicaragua, is composed of HCl and H2SO4 in systematically varying proportions. The dominance of HCl in volcanic acid rain makes it distinctly different from anthropogenic acid rain. The pH of volcanic acid rain is largely controlled by its HCl concentration. Volcanic acids are locally damaging, killing vegetation with the conspicuous exception of the shrubs Malanthora and Lantana. These shrubs have the ability to rapidly and completely neutralize acid rain by releasing K(+) at their leaf surfaces. The mechanism by which these plants sustain their acid neutralizing capacity is evidently by pumping acidity into the soil in exchange for K(+) from soil exchange surfaces. In effect the Malanthora shrub layer is acting as a short-term acid sink for incident acid rain. However, the final acid sink in this system is the base exchange reservoir of the local soils. (Alexander-PTT)
W87-05408

ESTIMATES OF THE SULFATE SCAVENGING COEFFICIENT FROM SEQUENTIAL PRECIPITATION SAMPLES ON LONG ISLAND,
State Univ. of New York at Stony Brook. Lab. for Planetary Atmospheres Research.
S. Hameed, and K. R. Sperber.
Tellus TELLAL, Vol. 38B, No. 2, p 118-126, April 1986. 2 fig, 5 tab, 36 ref.

Descriptors: *Precipitation scavenging, *Path of pollutants, *Acid rain, *Deposition, *Sulfates, *Model studies, *Rainfall rate, Transformation, Trend analysis, Long Island, Estimating.

Removal of water soluble pollutants by precipitation is a major atmospheric cleansing process. In most atmospheric photochemical models, scavenging due to precipitation is parameterized by a first-order rate coefficient lambda. By comparing deposition of sulfate in successive hours of precipitation samples taken over a 6-year period at Brookhaven National Laboratory (BNL) on Long Island in New York, we have estimated scavenging coefficients in air for sulfate under a variety of meteorological and seasonal conditions. The scavenging coefficients obtained are underestimated (typically up to 12%) because of liquid phase production of sulfate from SO2 scavenged in air. The square root transformation of the scavenging coefficients sq root lambda, yields an approximately normal distribution. An interesting property of the distribution of scavenging coefficients is that the ratios of the mean value of sq root lambda to its standard deviation cluster around the value 2.4; this property may limit the choice of stochastic models which describe the scavenging process. The mean value of the sulfate scavenging coefficient is .0001/s. A trend analysis of the relationship between the scavenging coefficients and rainfall rate indicates that the sulfate scavenging coefficient is virtually invariant for rainfall rates < or = 5 mm/h. (Alexander-PTT)
W87-05409

HISTOCHEMICAL DEMONSTRATION OF TWO MERCURY POOLS IN TROUT TISSUES: MERCURY IN KIDNEY AND LIVER AFTER MERCURIC CHLORIDE EXPOSURE,
Aarhus Univ. (Denmark). Inst. of Anatomy.
For primary bibliographic entry see Field 5A.
W87-05413

WATER AND CHLORIDE MOVEMENT THROUGH A LAYERED FIELD SOIL,
Science and Education Administration, Beltsville, MD.
J. L. Starr, J.-Y. Parlange, and C. R. Frink.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1384-1390, November-December 1986. 10 fig, 16 ref.

Descriptors: *Solute transport, *Path of pollutants, *Soil properties, *Infiltration, *Saturated flow, *Soil water, Loam, Sand, Soil surfaces, Tensiometers, Soil columns, Solutes, Transport, Flow, Chlorides, Soil texture.

Most research results on water and solute movement through soils are interpreted on the basis of average water and/or solute values across soil columns or from breakthrough curves. Owing to the inherent problems of assessing the representative cross-sectional area in the field, and obtaining

a meaningful average measurement from that area, there are no standard methods to assess the spatial distribution of the water and solute in a cross-sectional area on a field scale. This is particularly a problem under conditions in which the water and solute movement through the soil deviates greatly from the idealized one-dimensional flow model. Twenty porous ceramic samplers at each of four soil depths were arranged in a three-dimensional pattern to study the movement of water and Cl(-) through a layered sandy loam (sandy, mesic typic Dystrochrepts) over a gravely coarse sand with a perched water table at 180 cm. All samplers were used as tensiometers during the initial phase of the experiment in which salt-free water was ponded at the soil surface. After constant flow conditions were achieved, a pulse of 0.015 M CaCl2 solution was added to the infiltrating water and all samplers were then used to obtain soil water samples for Cl(-) analysis. Variations in soil water pressure were observed to be much smaller than the variations in Cl(-) concentration. Both water and Cl(-) data moved downward in a general one-dimensional pattern in the finer textured surface layer and in the zone directly above the water table, whereas, the movement between these two depths was three-dimensional, i.e., by fingering. (Alexander-PTT)
W87-05414

SUSPENSION CONCENTRATION EFFECTS ON DEPOSITIONAL CRUSTS AND SOIL HYDRAULIC CONDUCTIVITY,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 2G.
W87-05419

CALCULATING THE QUALITY OF DRAINAGE WATER FROM NON-HOMOGENEOUS SOIL PROFILES WITH AN EXTENSION TO AN UNSATURATED-SATURATED GROUNDWATER QUALITY MODEL INCLUDING BYPASS FLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 2F.
W87-05434

HEXACHLOROBENZENE, OCTACHLOROSTYRENE AND OTHER ORGANOCHLORINE COMPOUNDS IN WASTE WATER FROM INDUSTRIAL HIGH-TEMPERATURE PROCESSES INVOLVING CHLORINE,
J. Vogelgesang.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 4, p 140-144, August 1986. 3 fig, 1 tab, 31 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Industrial wastes, *Pollutant identification, *Organochlorine compounds, Pollutants, Hexachlorobenzene, Octachlorostyrene, Aluminum smelt, Wastewater, Industrial wastewater.

Little information exists about the origin of the widespread chlorinated pollutants hexachlorobenzene (HCB), which formerly was in use as an agricultural fungicide, and octachlorostyrene (OCS). It was shown that the treatment of an aluminum smelt with hexachloroethane and chlorine gas was responsible for the release of these two compounds. They were detected in the sewage from the exhaust washing device. Pentachlorobenzene, octachloronaphthalene and decachlorobiphenyl were also present; an unknown compound was detected and tentatively identified as hexachlorobenzothiophene. In another case, the treatment of an aluminum smelt with dichloroethane and Freon gas resulted in the formation of organochlorines and of pentachlorofluorobenzene. In the high-temperature industrial production of niobium and tantalum, chlorine gas was bubbled through the smelt of starting materials releasing HCB, OCS and decachlorobiphenyl. (Author's abstract)
W87-05456

INVESTIGATIONS FOR CHEMICAL REACTION OF A HIGH-GRADE STEEL WITH BERLIN DRINKING WATER (UNTERSUCHUNGEN ZUM CHEMISCHEN VERHALTEN VON EDELSTAHL IN BERLINER TRINKWASSER),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
W. Arts, H.-J. Bretschneider, and C. Landgraf.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 5, p 176-182, October 1986. 7 fig, 6 tab, 19 ref.

Descriptors: *Water pollution sources, *Materials testing, *Water analysis, *Pollutants, *Stagnant water, *Heavy metals, *Pipes, *Steel, *Alloys, *Drinking water, Berlin, Chromium, Nickel, Molybdenum, Flow measurement, Plumbing, Spectral analysis.

At a testing plant consisting of four different pipes (Mannesmann's material No. 1.4401 (X5CrNiMo1810)) coupled by pressure-fitting systems, stagnation and flow measurements of Berlin drinking water were made. Differential pulse stripping voltammetry registered chromium and nickel intake as the important alloying additions; the intake of molybdenum was determined by atomic absorption analysis. The results of the flow measurements showed very small intakes of chromium and nickel for all pipes. The stagnation times varied between 10 minutes and 47 hours, but the intake of heavy metals was negligible. Only the installation of another chromium-nickel composition led to contact corrosion after a few days and therefore to higher nickel concentration (up to 265 micrograms/l) in stagnated water. It was concluded that the inspected high-grade steel is suitable for household plumbing and would be a good alternative to the widely existing lead pipes. (Author's abstract)
W87-05460

RADIATION-CHEMICAL DEGRADATION OF TRACES OF TRICHLOROETHYLENE AND PERCHLOROETHYLENE IN DRINKING WATER (DER STRAHLENCHEMISCHE ABBAU VON TRICHLORATHYLEN- UND PERCHLORATHYLENSPUREN IN TRINKWASSER),
For primary bibliographic entry see Field 5F.
W87-05463

ROLE OF ALKALINE PHOSPHATASE IN THE SEDIMENTS OF VENICE LAGOON ON NUTRIENT REGENERATION,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5C.
W87-05486

DISTRIBUTION AND ACCUMULATION OF ROTENONE IN TISSUES OF WARMWATER FISHES,
National Fishery Research Lab., La Crosse, WI.
J. J. Rach, and W. H. Gingerich.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 2, p 214-219, March 1986. 1 fig, 2 tab, 17 ref.

Descriptors: *Path of pollutants, *Bioaccumulation, *Isotope studies, *Rotenone, *Tissue analysis, *Population exposure, *Fish populations, *Metabolism, Carp, Bluegills, Yellow perch, Chromatography.

The tissue distribution of rotenoid residues was determined in tissues of common carp Cyprinus carpio (88.2 g), bluegills Lepomis macrochirus (47.9 g), and yellow perch Perca flavescens (67.7 g) after the fish were exposed to 50 microgram(ug)/L of rotenone-6a-14C (159000 Bq/micromole). Exposures were terminated 1 h after the fish were moribund and failed to respond to gentle prodding. The fish were dissected, and various tissues were oxidized to determine 14C-rotenone accumulation and distribution. Major rotenone metabolites were identified by gradient-elution high performance liquid chromatography. The exposure time required for fish to reach total incapacitation was 3 h for bluegills and yellow perch, and 11.25 h for common carp. The mean rotenoid concentrations (ug/100g fish) in the whole body were 22.4 in yellow perch, 39.7 in bluegills, and 107.8 in common carp. The percentage of rotenone-derived 14C activity was higher in the carcass components than in the head or viscera; the skin and bone contained about 60% of the carcass activity. The highest relative rotenoid concentrations were found in the liver, bile, gills, brain, and heart. Percentages of total rotenoid material as parent rotenone were highest in yellow perch (70.0 in the viscera and 84.4 in the fillet), followed by those for bluegills (22.7 and 27.8) and common carp (9.7 and 48.5). (Author's abstract)
W87-05495

FECUNDITY AND TRACE-METAL CONTENT OF CREEK CHUBS FROM A METAL-CONTAMINATED STREAM,
Ohio State Univ., Columbus. Environmental Biology Program.
For primary bibliographic entry see Field 5C.
W87-05498

ATRAZINE UPTAKE, PHOTOSYNTHETIC INHIBITION, AND SHORT-TERM RECOVERY FOR THE SUBMERSED VASCULAR PLANT, POTAMOGETON PERFOLIATUS L.,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 5C.
W87-05502

UPTAKE OF POLYCHLOROBIPHENYL CONGENERS BY PURPLE LOOSESTRIFE (LYTHRUM SALICARIA) ON THE BANKS OF THE HUDSON RIVER,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
B. Bush, L. A. Shane, L. R. Wilson, E. L. Barnard, and D. Barnes.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 15, No. 3, p 285-290, 1986. 3 fig, 3 tab, 11 ref.

Descriptors: *Bioaccumulation, *Polychlorinated biphenyls, *Purple loosestrife, *Hudson River, *Path of pollutants, Transport, Waste dumps, Transplanting, Translocation, Congeners, Roots, Metabolism.

Recent developments in glass capillary chromatography allow precise analysis of 74 congeners in standard industrial PCB mixtures. Such detailed analyses prove useful in discerning subtle yet crucial properties of PCB transport and allow the discovery of ecological pathways of these toxins. Transport of 42 polychlorobiphenyl (PCB) congeners by purple loosestrife (Lythrum salicaria) in two ecosystems is reported. The contaminated site was beside the Hudson River at Albany, New York, and the control site was two miles distant on wasteland. By transplanting and translocating the plants between the sites, systemic uptake from the roots and uptake from the air were determined. Uptake from ambient air was also measured with a 0.2-cu m field sampling chamber. The dominant route of uptake by the plant was via the roots. At high ambient concentrations (140 ng/cu m) PCB was scavenged from the air by the plants. At low ambient concentrations (8 ng/cu m) 2-chlorobiphenyl and 2,2' -dichlorobiphenyl were emitted by the plants. (Alexander-PTT)
W87-05503

ACID PRECIPITATION EFFECT ON ANION TRANSPORT OF THE ATKINS RESERVOIR, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Chemistry.
B. Tan, R. M. Ruggiero, O. T. Zajicek, and G. M. Dabkowski.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 15, No. 3, p 321-326, 1986. 5 fig, 17 ref.

Descriptors: *Acid rain effects, *Path of pollutants, *Anion transport, *Atkins reservoir, *Reservoirs, *Watersheds, *Acid rain, *Precipitation, Ni-

trates, Sulfates, Chlorides, Fluorides, Alkalinity, Ions, Bioaccumulation, Decomposition.

The anion concentration of the water in the precipitation reservoir and its watershed of Atkins Reservoir, Massachusetts was studied. In the precipitation study, the NO3(-) and SO4(2-) levels increased with a pH drop and vice versa, but the Cl(-) was interfered with by regional marine air masses. The average pH of precipitation and the reservoir were 3.85 and 6.08 respectively. The average alkalinity of the reservoir was very low; 0.88 mg/L CaCO3. The precipitation and reservoir concentrations of anions were: F(-) (0.5 and 0.2 ppm), Cl(-) (2 and 4 ppm), and SO4(2-) (7 and 7.8 ppm), respectively. The NO3(-) level in the precipitation (4 to 6 ppm) was at least an order higher than the reservoir (0.2 to 0.4 ppm) and this was due to selective NO3(-) uptake by terrestrial plants. About 50% of the samples collected at the bottom of the reservoir were high in NO3(-) where organic decomposition would be expected. The response of the SO4(2-) and Cl(-) levels to pH drop in the reservoir inlet study followed a SO4(2-) retention-Cl(-) release mechanism. The F(-) concentration in the precipitation and reservoir was not dependent on pH changes. The lack of F(-) in soil samples adjacent to the reservoir indicated that the F(-) in the reservoir came primarily from precipitation. (Author's abstract)
W87-05504

FLUORIDE ADSORPTION BY A SALINE SODIC SOIL IRRIGATED WITH A HIGH F WATER,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
C. W. Robbins.
Irrigation Science IRSCD2, Vol. 7, No. 2, p 107-112, 1986. 1 fig, 1 tab, 8 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Fluorides, *Fluorites, *Saline soils, *Irrigation, *Adsorption, Isotherms, Lysimeters, Geothermal well water, Langmuir equation, Soil solution, Ions, Drinking water .

Many deep aquifers and geothermal waters in the western United States contain high fluoride (F) concentrations (0.2 to 1.0 mM F). This concentration is higher than the 0.1 mM F (2mg F/kg) generally considered acceptable for human or livestock drinking water. Langmuir isotherm data for F adsorption were obtained from 1:10 soil:water extracts of soil samples from a lysimeter study. A sodic silt loam surface soil with a saline sodic subsoil was irrigated with a high sodium chloride, high fluoride (0.38 mM F) geothermal well water. A previous study showed that fluorite (CaF2) was precipitated from solution in the upper portion of this profile while another mechanism removed F solution in the lower part of the profile to below 0.02 mM F. The Langmuir isotherm data indicate that one kind of surfaces or sites remove fluoride from solution over the 0 to 1.1 to 1.2 mMF range. The adsorption capacity for this F removal is about 4.4 to 5.8 mmol F/kg of soil and the equilibrium constant is between 0.54 to 1.00 l/mmol F. Once these surfaces or sites were saturated, a second kind of sites removed F from solution, and had an adsorption capacity of 9.2 to 11.4 mmol/kg and an equilibrium constant of 0.16 to 0.27 l/mmol. Both data sets fit the Langmuir equation. At some point before or after this second set of sites or surfaces was saturated, the fluorite ion activity product was exceeded and fluoride was then removed rom solution via fluorite precipitation. The two adsorption mechanisms lowered the soil solution F concentration sufficiently to prevent ground water contamination, but once the adsorption sites were saturated, fluorite precipitation does not decrease F concentration sufficiently to meet drinking water standards. (Alexander-PTT)
W87-05508

DISTRIBUTION AND PRODUCTION OF CHIRONOMUS IN EUTROPHIC LAKE NGAPOURI,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
For primary bibliographic entry see Field 2H.
W87-05515

ENTEROVIRUSES OF HUMAN ORIGIN AND FAECAL COLIFORMS IN RIVER WATER AND SEDIMENTS DOWN STREAM FROM A SEWAGE OUTFALL IN THE TAIERI RIVER, OTAGO,
Otago Univ., Dunedin (New Zealand). Dept. of Microbiology.
G. D. Lewis, F. J. Austin, and M. W. Loutit.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 101-105, 1986. 2 fig, 2 tab, 22 ref.

Descriptors: *Water pollution effects, *Pollutant identification, *Enteroviruses, *Coliforms, *Sediments, *Outfall sewers, *Rivers, Feces, Downstream, Taieri River, New Zealand, Viruses, Survival, Effluents, Temperature.

Sediment and water column samples were collected at eight sites on the Taieri River down stream from a sewage outfall on six occasions between January and March 1984. These samples were tested for enteroviruses of human origin and fecal coliforms. Enteroviruses were detected in the water column and sediments on most occasions up to 4 km down stream and in sediment on one occasion up to 19.5 km down stream. Fecal coliform numbers were high in all samples. Enterovirus and fecal coliform numbers were at least ten times greater in sediments than in the overlying water. Viruses recovered were Poliovirus types 1, 2, and 3 and two isolates which could not be identified using the Lim Benyeah-Melnick pooled antisera. The effect of temperature on enterovirus survival in fresh water is discussed. (Author's abstract)
W87-05517

LITTORAL SEDIMENT TRANSPORT AT MANGATAWHIRI SPIT, NEW ZEALAND,
Centre for Resource Management, Canterbury (New Zealand).
For primary bibliographic entry see Field 2J.
W87-05519

TRAJECTORY ANALYSIS OF ACID DEPOSITION DATA FROM THE NEW JERSEY PINE BARRENS,
Washington State Univ., Pullman. Program in Environmental Science and Regional Planning.
W. W. Budd.
Atmospheric Environment ATENBP, Vol. 20, No. 12, p 2301-2306, December 1986. 8 fig, 1 tab, 22 ref.

Descriptors: *Acid rain, *Water pollution sources, *Regional analysis, *Acid precursor emissions, *Sulfur oxides, *Nitrogen oxides, *Trajectory analysis, *Air pollution, New Jersey, Pine Barrens, Precipitation.

An assessment of trajectories associated with storms affecting McDonald's Branch watershed (New Jersey, 39 deg 50 min N, 74 deg 30 min W) is presented. A simple classification system is used to examine regional contributions of acid precursors. The results suggest that major regional sources of acid precursor emissions (sulfur oxides, nitrogen oxides) dominated precipitation acidity for the Pine Barrens region from 1978 to 1981. An incremental approach to acid precipitation policy is suggested. (Author's abstract)
W87-05540

GAS-PHASE REACTION OF THE METHYLPEROXY RADICAL WITH SULPHUR DIOXIDE,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 2K.
W87-05541

ATMOSPHERIC DEPOSITION OF TOXAPHENE TO EASTERN NORTH AMERICA DERIVED FROM PEAT ACCUMULATION,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
R. A. Rapaport, and S. J. Eisenrich.
Atmospheric Environment ATENBP, Vol. 20, No. 12, p 2367-2379, December 1986. 8 fig, 3 tab, 75 ref. NSF Grant DEB 7922142.

Descriptors: *Path of pollutants, *Deposition, *Precipitation, *Toxaphene, *Peat, *Accumulation rates, Eastern North America, DDT, Insecticides, Air pollution, Polychlorinated biphenyls, Pesticides.

Dated peat cores from Minnesota east to Nova Scotia (Canada), analyzed for toxaphene, provided spatial variation in historical and recent atmospheric fluxes and an atmospheric input function for toxaphene extending over the past 40 yr. This input function is consistent with toxaphene production data and the input of a well-documented insecticide, DDT. Total core burdens of toxaphene across a west to east transect were highest in the upper midwest and Nova Scotia, with recent peat accumulation rates ranging from 0.5 to 9 microgram/sq m/yr. Atmospheric concentrations of toxaphene, back-calculated from accumulation rates in peat, range from 8 to 150 picogram/cu m, in agreement with recently-measured concentrations in remote atmospheres. Recent atmospheric inputs of toxaphene are two to four times those of polychlorinated biphenyls and DDT, respectively. (Author's abstract)
W87-05542

SURVEY OF LEAD, CADMIUM AND FLUORIDE IN HUMAN MILK AND CORRELATION OF LEVELS WITH ENVIRONMENTAL AND FOOD FACTORS,
Health and Welfare Canada, Ottawa (Ontario). Food Research Div.
R. W. Dabeka, K. F. Karpinski, A. D. McKenzie, and C. D. Bajdik.
Food and Chemical Toxicology FCTOD7, Vol. 24, No. 9, p 913-921, September 1986. 4 tab, 35 ref.

Descriptors: *Path of pollutants, *Pollutant identification, *Statistical analysis, *Lead, *Cadmium, *Fluoride, *Milk, *Human physiology, Statistics, Air pollution, Fluoridation, Drinking water, Housing, Cigarette smoke, Heavy metals.

Pb, Cd, and F were determined in 210 samples of human milk and the mean and median levels and ranges found were 1.04 and 0.55 nanogram (ng)/g (range <0.05-15.8 ng/g) for Pb, 0.08 and 0.06 ng/g (range < 0.001-4.05 ng/g) for Cd, and 7.08 and <4 ng/g (range <2-97 ng/g) for F. For mothers taking no F supplements and living in communities with F in the drinking water, the mean F level was 9.8 ng/g; where no F was present in the drinking water, the mean levels was 4.4 ng/g. Geometric means for non-zero Pb, Cd, and F concentrations were 0.566, 0.063, and 12 ng/g, respectively. Statistical correlation of levels with some dietary and environmental factors showed that Pb levels were correlated most strongly with the age of the house ($P < 0.001$), with maternal exposure to heavy traffic for more than 5 yr ($P = 0.011$), and with coffee consumption ($P = 0.034$). F levels correlated strongly ($P = 0.007$) with the presence of F in the drinking-water. Cd levels correlated strongly with exposure to cigarette smoke ($P = 0.005$ if the mother smoked and $P = 0.003$ if the father smoked and the mother did not). (Author's abstract)
W87-05550

CHLORINATING POULTRY CHILLER WATER: THE GENERATION OF MUTAGENS AND WATER RE-USE,
Western Regional Research Center, Berkeley, CA.
M. S. Masri.
Food and Chemical Toxicology FCTOD7, Vol. 24, No. 9, p 923-930, September 1986. 8 tab, 22 ref.

Descriptors: *Food-processing wastes, *Water pollution effects, *Water pollution sources, *Water reuse, *Chlorination, *Poultry, *Mutagens, Chiller water, Water treatment, Chlorine, Industrial wastewater, Ames test, Monitoring.

Potential of generation of mutagens by chlorination of water used to chill poultry carcasses was assessed. Unchlorinated chiller water from a nearby poultry processing plant was chlorinated to different levels in the laboratory. Residues of dichloromethane extracts of the treated water were tested for mutagenicity with the Ames Salmonella reverse mutation system. The rate of disappearance of added chlorine from the chiller waters was monitored using ferrous ammonium sulfate titration. The results showed a fast rate of disappearance of added free chlorine, only some of which reappeared as combined available chlorine. No mutagenic activity could be demonstrated at chlorination levels up to 100 ppm, but activity rose above 250 ppm, and a dose-response relationship was demonstrated. The significance of these findings for poultry processing is discussed. (Author's abstract)
W87-05551

BEHAVIOR OF 226RA IN THE MISSISSIPPI RIVER MIXING ZONE,
Texas A and M Univ., College Station. Dept. of Oceanography.
D. G. Moore, and M. R. Scott.
Journal of Geophysical Research (C) JGRCEY, Vol. 91, No. 12, p 14317-14329, December 1986. 5 fig, 5 tab, 45 ref. NSF Grant OCE 8117610 and DOE Contract DE-AS05-76-EV03852.

Descriptors: *Path of pollutants, *Radium-226, *Mississippi River, *Mixing, *Radium radioisotopes, Rivers, Salinity, Dissolved solids.

The behavior of 226Ra in the Mississippi River mixing zone is strongly nonconservative and includes desorption similar to that reported for the Hudson, Pee Dee, and Amazon Rivers. However, dissolved and desorbed 226Ra concentrations in the Mississippi are 2 to 5 times greater than in the other rivers at the same salinity. Radium concentrations vary inversely with the water discharge rate. The 226Ra desorption maximum occurs at a salinity of 5.0, much lower than the 18 to 28 salinity values for the maxima of the other three rivers. High concentrations of dissolved 226Ra (up to 82 dpm per 100 l) and the low salinity values for the desorption maximum in the Mississippi River result from three major factors. The annual contribution 226Ra to the ocean from the Mississippi River is 3.7 x 10 to the 14th power disintegrations per minute/yr, based on data from three cruises. Evidence of flux of 226Ra from estuarine and shelf sediments is common in vertical profile sampling of the deltaic waters but is not reflected in calculations made with an 'apparent' river water Ra value extrapolated to zero salinity. (Author's abstract)
W87-05557

JET BEHAVIOUR IN SHALLOW RECEIVING WATER,
James Cook Univ. of North Queensland, Townsville (Australia).
For primary bibliographic entry see Field 8B.
W87-05567

PREDICTING THE OCCURRENCE OF 228RA IN GROUND WATER,
Research Planning Inst., Inc., Columbia, SC.
J. Michel, and C. R. Cothern.
Health Physics HLTPAO, Vol. 51, No. 6, p 715-721, December 1986. 1 fig, 1 tab, 12 ref.

Descriptors: *Model studies, *Water quality, *Pollutant identification, *Groundwater contamination, *Radium radioisotopes, *Radium-228, *Drinking water, *Statistical models, Prediction, Aquifer characteristics, Isotope studies, Groundwater, Aquifers.

A conceptual model is presented to predict the relative probability of occurrence of elevated 228Ra in public drinking water supplies (those serving more than 25 people or 15 connections) using groundwater sources. The model is based on an aquifer classification scheme, which was developed from an understanding of the geochemical and radiological behavior of 228Ra and its parent, 232Th. Using this model, all aquifer types are classified as low, medium, or high probability of having elevated 228Ra. Summaries of the available data are discussed to show the actual concentrations found in each type of aquifer. As part of the initial application of this approach to develop a nationwide occurrence profile for 228Ra, all counties in the United States were classified and a map presented to show the distribution of the three classes. Nationwide, 71% of the counties were ranked as low, 18% as medium, and 11% as high. (Author's abstract)
W87-05584

PHOTOMETRIC DETERMINATION OF TIN, ZIRCONIUM, NIOBIUM, AND TANTALUM IN SEA ALGAE,
Fiziko-Khimicheskii Inst., Odessa (USSR).
For primary bibliographic entry see Field 5A.
W87-05585

CLUSTER ANALYSIS APPROACH TO STUDY HEAVY METALS DISTRIBUTION IN MARINE ORGANISMS,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
A. Voulgaropoulos, V. Simeonov, K. Fytianos, and G. Vasilikiotis.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 325, No. 5, p 477-478, November 1986. 2 tab, 3 ref.

Descriptors: *Heavy metals, *Mussels, *Fish, *Path of pollutants, *Bioaccumulation, *Tissue analysis, *Cluster analysis, Aegean Sea, Mathematical analysis, Fate of pollutants, Greece.

Cluster analysis was applied to data on heavy metals in tissues of fish and mussels collected in the North Aegean sea in an attempt to classify raw analytical data. Eight different sampling areas in the Thermaikos, Strymonikos, and Kaval Gulf regions were classified; there were 18 variables (V): Pb, Cd, and Hg content for the period 1976-79 (V 1-3), for the period 1980-83 (V 4-6) in Mytilus galloprovincialis; same metals and same periods of time in Mullus barbatus (V 7-12), and same metals and same periods of time in Merlucius merlucius (V 13-18). The clustering, performed according to the average linkage method with Euclidean distance as the similarity measure, showed that the three different regions possess an 'internal' similarity with respect to marine organism pollution. The Thermaikos and Strymonikos Gulfs are more similar to each other than either is to Kaval Gulf in terms of the variables used. (Rochester-PTT)
W87-05586

CADMIUM AND ZINC INFLUX CHARACTERISTICS BY INTACT CORN (ZEA MAYS L.) SEEDLINGS,
Auburn Univ., AL. Dept. of Agronomy and Soils.
G. L. Mullins, and L. E. Sommers.
Plant and Soil PLSOA2, Vol. 96, No. 2, p 153-164, 1986. 5 fig, 4 tab, 31 ref. TVA Contract TV-58640A.

Descriptors: *Path of pollutants, *Bioaccumulation, *Corn, *Seedlings, Plant growth, *Cadmium, *Zinc, *Soil solution, *Soil water, Michaelis-Menten kinetics, Kinetics, Ions, Cations, Absorption, Depletion, Mathematical equations, Mathematical studies, Nutrients, Accumulation.

Cadmium and zinc uptake parameters were determined for intact corn (Zea mays L.) seedlings grown for 15 and 22 d in nutrient solutions containing levels of Cd and Zn that were similar to those found in soil solutions. Uptake of both elements was assumed to follow Michaelis-Menten kinetica. Calculations were based on the concentrations of free ionic Cd (Cd(2+)) and Zn (Zn(2+)) rather than the total solution concentration. Rates of Zn uptake were measured by determining depletion of Zn for periods of up to 30 h from solutions containing initial concentrations of 2.5 and 10 micromol Zn/l. Depletion curves suggested that Zn uptake characteristics were similar at both levels of Zn in solution. The Imax for Zn uptake decreased form 550 to 400 pmol/sq m root surface/s between 16 and 22 d of growth while Km decreased from 2.2 to 1.5 micromol Zn(2+)/l. Cadmium uptake parameters were measured by controlling Cd(2+) activities in nutrient solution between 6.3 to 164 nmol/l by continuous circulation of nutrient solution through a mixed-resin system. Imax for Cd uptake was 400 pmol/sq m root surface/s at 15 and 22 d of growth. The magnitude of Km increased from 30 to 100 nmol Cd(2+)/l during this time period. The Km value suggests that corn is efficient for Cd uptake. The results of these uptake studies are consistent with the observed uptake of Zn and Cd by corn seedlings in soils. (Author's abstract)
W87-05591

CHANGING CONCEPTS AND IMPROVED METHODS FOR EVALUATING THE IMPORTANCE OF PCBS AS DREDGED SEDIMENT CONTAMINANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W87-05599

PHOSPHATE DETERGENTS - A CLOSER LOOK,
Soap and Detergent Association, New York.
K. A. Booman, and R. I. Sedlak.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 12, p 1092-1100, December 1986. 4 fig, 3 tab, 36 ref.

Descriptors: *Water pollution sources, *Water pollution control, *Water pollution effects, *Path of pollutants, *Detergents, *Phosphates, *Water pollution, *Phosphorus removal, Evaluation, Municipal wastewater, Industrial wastes, Economic aspects, Phosphorus compounds, Phosphorus, Effluents, Chesapeake Bay, Maryland, District of Columbia.

Recent detergent phosphate bans in Maryland and the District of Columbia have stimulated interest in this as a means of nutrient control. An assessment of the role of detergent phosphorus bans in a remedial program, including the impact on operations for phosphorus removal at municipal wastewater treatment plants, was made. A summary of the information on these topics that is pertinent to the Chesapeake Bay region was presented. Field studies have demonstrated that phosphate detergent bans have not resulted in detectable improvements in water quality, so no quality improvements are expected in the Chesapeake Bay as a result of the bans in Maryland and the District of Columbia. Preliminary estimates of the reductions in phosphorus that enter the treatment plant in the area were consistent with reductions observed previously. Wastewater treatment data indicate that detergents contribute approximately 0.3 kg P/cap.a to municipal wastewater. It was concluded that there is no practical economic or environmental benefit associated with the phosphate detergent ban in the studied area. (Wood-PTT)
W87-05603

ARYL HYDROCARBON HYDROXYLASE LEVELS IN HERRING GULL EMBRYOS FROM DIFFERENT LOCATIONS ON THE GREAT LAKES,
National Wildlife Research Centre, Ottawa (Ontario).
J. A. Ellenton, L. J. Brownlee, and B. R. Hollebone.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 615-622, 1985. 2 fig, 3 tab, 46 ref.

Descriptors: *Enzymes, *Water pollution effects, Path of pollutants, *Bioindicators, *Herring gulls, *Embryos, *Great Lakes, *Tissue analysis, Organic compounds, Water birds, Eggs, Pollutants.

Aryl hydrocarbon hydroxylase (AHH) levels were measured in the livers of herring gull (Larus argentatus) embryos to determine if monooxygenase activity in this species could be used as a 'bioeffects' monitor of environmental contamination. Herring gull eggs were collected in 1981 from five loca-

tions on the Great Lakes Basin and from one clean colony on the Atlantic coast. Microsomal protein determinations and AHH assays were conducted on livers from the embryos at 20 and 25 d of incubation. Organochlorines (DDE, DDT, tetrachlorobenzene, pentachlorobenzene, hexachlorobenzene, heptachlor epoxide, chlordane, dieldrin, mirex, photomirex, polychlorinated biphenyls and 2,3,7,8-tetrachlorodibenzo-p-dioxin) were also measured in egg homogenates from each colony. The 25-d embryos were found to be the most suitable for AHH analysis, since they had a higher baseline level and a greater response than did the 20-d embryos. Specimens from two of the Great Lakes colonies had significantly higher AHH activities than was found for the Atlantic coast colony. These levels of AHH activity closely paralleled the concentrations of 2,3,7,8-tectrachlorodibenzo-p-dioxin present in eggs gathered from the colonies in 1980. Further work regarding monoxygenase levels in herring full embryos is discussed. (Author's abstract)
W87-05619

GEOCHEMICAL INVESTIGATIONS OF POLYCHLORINATED DIBENZO-P-DIOXINS IN THE SUBSURFACE ENVIRONMENT AT AN ABANDONED WOOD-TREATMENT FACILITY,
Geological Survey, Denver, CO.
W. E. Pereira, C. E. Rostad, and M. E. Sisak.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 629-639, 1985. 7 fig, 4 tab, 26 ref.

Descriptors: *Path of pollutants, *Dioxins, *Pollutant identification, Waste disposal, *Effluents, *Aquifers, *Groundwater, Porous media, Zones, Organic compounds, Spectral analysis, Chromatography, Pensacola, Florida.

The discharge of effluents containing creosote and pentachlorophenol into two unlined surface impoundments at a wood-treatment facility in Pensacola, Florida, resulted in contamination of the underlying sand and gravel aquifer. These wastes contained significant amounts of chlorinated dioxins, such as isomers of hexa- and heptachlorodibenzo-p-dioxins and octachlorodibenzo-p-dioxin, probably derived from commercial pentachlorophenol. Geochemical investigations of pond sludge, groundwater and porous media from the unsaturated and saturated zones indicated that these geologic materials were contaminated by chlorinated dioxins. The fate and movement of these compounds in the subsurface environment were studied using the technique of GC-MS-MS. Chlorinated dioxins migrated both vertically and horizontally in the subsurface and were present at considerable distances from the source of contamination. Concentrations of chlorinated dioxins in groundwater were several orders of magnitude lower than in porous media from the unsaturated and saturated zones. Ratios of the various isomers remained relatively constant in highly contaminated areas. However, in less contaminated areas, isomer ratios changed dramatically; at certain locations, one hexachlorodibenzo-p-dioxin isomer predominated. The environmental significance of these compounds is discussed. (Author's abstract)
W87-05620

EFFECTS OF APPLICATION PROCEDURES AND IRRIGATION ON DEGRADATION AND MOVEMENT OF ALDICARB RESIDUES IN SOIL,
Wisconsin Univ.-Madison. Dept. of Entomology.
J. A. Wyman, J. O. Jensen, D. Curwen, R. L. Jones, and T. E. Marquardt.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 641-651, 1985. 2 fig, 9 tab, 8 ref.

Descriptors: *Path of pollutants, *Irrigation, *Fate of pollutants, *Aldicarb, *Groundwater pollution, *Degradation, *Bioaccumulation, *Insect control, *Crop yield, *Potatoes, Evapotranspiration, Insecticides, Pesticides, Soil properties, Leaching.

Aldicarb was applied to potato plants in two locations in Wisconsin to determine the effects of application procedures and irrigation on degradation and movement of aldicarb residues, plant uptake, insect control and crop yield. Two application procedures (3.36 kg AI/ha applied in the furrows at planting and 2.24 kg AI/ha applied as a top-dress application consisting of a surface-applied band covered with soil at plant emergence) and two irrigation regimens (medium water use based on evapotranspiration and heavy water use based on evapotranspiration plus 60%) were tested. The emergence application was effective in reducing the downward movement of aldicarb residues without significantly affecting performance as measured by insecticidal efficacy, crop residues and yield. Excess irrigation increased downward movement of aldicarb residues in soil, diminished foliar residues and resulted in decreased insect control and crop yield. Differences in soil characteristics, primarily in water-holding capacity, were important in reducing downward movement of aldicarb in soil. (Author's abstract)
W87-05621

MEASUREMENT OF WATER SOLUBILITIES, OCTANOL/WATER PARTITION COEFFICIENTS AND VAPOR PRESSURES OF COMMERCIAL PHTHALATE ESTERS,
Syracuse Research Corp., NY. Life and Environmental Sciences Div.
P. H. Howard, S. Banerjee, and K. H. Robillard.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 653-661, 1985. 2 fig, 5 tab, 18 ref. Chemical Manufacturers Association Contracts PE-11.0-WS-SRC and PE-17.0-ET-SRC; EPA Grant R808613; NBS Grant NB18NADA2074.

Descriptors: *Path of pollutants, *Solubility, *Partition coefficient, *Vapor pressure, *Phthalate esters, Octanol, Organic compounds, Physicochemical properties.

The measurement of physiochemical parameters such as water solubility, octanol/water partition coefficient and vapor pressure is now an integral part of environmental exposure assessments because it provides considerable insight into how a chemical will be transported in the environment. Water solubilities, octanol/water partition coefficients and vapor pressures were measured for a variety of commercial phthalate esters, several of which were mixtures. The results provide insight into the applicability of the procedures, which were developed for pure compounds, to more complex industrial products and formulations. (Alexander-PTT)
W87-05622

FATE OF THREE PHOSPHATE ESTER FLAME RETARDANTS IN SMALL PONDS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, D. Lint, and N. P. Grift.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 663-675, 1985. 6 fig, 3 tab, 27 ref.

Descriptors: *Fate of pollutants, *Phosphate esters, *Bioaccumulation, *Flame retardants, *Ponds, *Isotope studies, *Sediments, Water analysis, Chromatography, Larvae, Fish, Organic compounds, Field tests, Phosphates.

The fate of 14C-labeled t-butylphenyldiphenyl phosphate (tBPDP), 2-ethylhexyl diphenyl phosphate (EHDP) and tri(m-cresyl) phosphate (mTCP) was studied for up to 360 d following addition of each compound to artificial ponds (5 cu m volume) to give initial water concentrations of about 50 microgram(ug)/L. Concentrations of each phosphate ester decreased rapidly, with half-lives of about 0.5 d for each compound. Concentrations of intact esters in bottom sediments decreased more slowly, with half-lives of 39 d for tBPDP and mTCP and 79 d for EHDP. A series of unidentified 14C-labeled nonpolar oxidation products, as well as diaryl phosphates, was isolated by TLC analysis of extracts of water and sediment. Concentrations of 197 ng/cu m tBPDP and 32 ng/cu m EHDP were detected in air (5 cm height) above the ponds during the first 18 h after the addition of the esters to the water. Volatilization losses during the experiment were estimated to represent less than 10% of the amounts added to the water initially. Maximum concentrations in fathead minnows (Pimephales promelas), ranging from 7.3 ug/g for mTCP to 10 ug/g for tBPDP, were observed 8 h after application. Chironomid larvae collected from bottom sediments accumulated concentrations that were 11- to 37-fold greater than levels of each compound present in sediment. After 360 d, most of the remaining 14C was present in bottom sediment, representing 24 to 30% of the amount originally added. (Author's abstract)
W87-05623

ACCUMULATION OF ZINC BY RAINBOW TROUT AS INFLUENCED BY PH, WATER HARDNESS AND FISH SIZE,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-05625

ENLARGED LIVERS AND HEPATIC MICROSOMAL MIXED-FUNCTION OXIDASE COMPONENTS IN TUMOR-BEARING BROWN BULLHEADS FROM A CHEMICALLY CONTAMINATED RIVER,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W87-05627

INFLUENCE OF MICROBIAL ADAPTATION ON THE FATE OF ORGANIC POLLUTANTS IN GROUND WATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. T. Wilson, J. F. McNabb, J. W. Cochran, T. H. Wang, and M. B. Tomson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 721-726, 1985. 2 fig, 2 tab, 8 ref. EPA Cooperative agreement CR806931-02.

Descriptors: *Pollutant identification, *Fate of pollutants, *Microbial adaptation, *Groundwater, *Organic compounds, *Acclimatization, *Contaminant plumes, Waste dumps, Waste disposal, Plumes, Biodegradation, Oxygen, Microorganisms.

The United States is becoming acutely aware that inappropriate disposal of hazardous waste is a threat to our groundwater resources. A clear understanding of the behavior of these wastes in the subsurface environment is required to properly assess the environmental damage from existing waste disposal sites and to identify the most appropriate approaches for containment or cleanup of the waste. A plume of contaminated groundwater originating from an abandoned disposal pit for wood-creosoting waste was characterized. The important organic contaminants in the plume include naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, dibenzofuran and fluorene at individual concentrations of 1,000 to 100 microgram/L. Core material from the site was studied to determine if organisms in the subsurface could adapt to this waste and if biological activity influenced the disposition of the plume. Biodegradation of these organic pollutants in subsurface material from the margin of the plume was rapid. No biodegradation of the pollutants was detected in pristine subsurface material from the same geological structure. As a result of this adaptation, the disposition of the plume was not controlled by the rate of utilization of the pollutants by the microorganisms but by the extent of utilization allowed by the supply of oxygen. (Alexander-PTT)
W87-05629

CHARACTERIZING THE AEROBIC AND ANAEROBIC MICROBIAL ACTIVITIES IN SURFACE AND SUBSURFACE SOILS,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
T. E. Ward.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 727-737, 1985. 1 fig, 4

tab, 31 ref.

Descriptors: *Fate of pollutants, *Waste disposal, *Septic tanks, *Microbial activity, *Aerobic conditions, *Anaerobic conditions, *Isotope studies, *Biodegradation, Microorganisms, Mineralization, Denitrification, Organic compounds.

Studies were conducted to characterize the aerobic and anaerobic microbial activities in surface and subsurface soils of septic tank tile fields. Under aerobic conditions, the indigenous microflora in the soils degraded the natural substrates and many of the synthetic chemicals tested. Half-lives (t sub 1/2) for the biodegradation (14CO2 production) of glucose and glutamic acid ranged from 2 to 5 h in surface soils and from 8 to 25 h in subsurface soils. Degradation of stearic acid was slower in both surface (t sub 1/2 = 118 h) and subsurface (t sub 1/2 = 82 to 312 h) soils. 14CO2 evolution from the synthetic chemicals methyl parathion and 2,4-D was more variable than that from the natural substrates and occurred in the surface soil but in only one of the two subsurface soils tested. The aerobic biodegradation of nitrilotriacetate (NTA) was studied only in the two subsurface soils from the tile fields. NTA was mineralized in both soils and the half-life for 14CO2 production ranged from 86 to 161 h. When the surface and subsurface soils were incubated under anaerobic (nitrate-reducing) conditions, active denitrification by the indigenous microflora was observed. In surface soils, denitrification occurred immediately after an anaerobic preincubation (12 to 24 h) and the N2O production curve was linear. In subsurface soils, N2O production occurred only after 32 to 44 h of anaerobic incubation and was described by an S-shaped curve. Biodegradation of the natural substrates (glucose, glutamic and acetic acid) under these anaerobic conditions ranges from 1 to 2 h for the surface soil to 2 to 20 h for subsurface soils. The half-life for the anaerobic mineralization of NTA ranged from 49 to 125 h in the subsurface soils. The results indicate that the indigenous microflora in the subsurface have lower activities than do those in surface soils; however, the subsurface microflora can effectively mineralize natural and certain synthetic substrates under aerobic and denitrifying conditions. (Author's abstract)
W87-05630

BIOTRANSFORMATION OF CHLORINATED ORGANIC SOLVENTS IN STATIC MICROCOSMS,

Florida International Univ., Miami. Drinking Water Quality Research Center.
F. Parsons, G. B. Lage, and R. Rice.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 739-742, 1985. 2 tab, 11 ref.

Descriptors: *Path of pollutants, *Biotransformation, *Organic solvents, *Chlorinated hydrocarbons, *Model studies, *Water pollution sources, *Microcosms, *Groundwater, *Aquifers, *Sediments, Incubation, Chromatography, Microorganisms, Organic compounds.

The presence of trichloromethane and volatile chlorinated ethene compounds in local groundwater, where no use of these compounds could be determined, prompted a search for their source using models of the aquifer in the laboratory. Preliminary work indicated that chloroethene and cis- and trans-1,2-dichloroethene resulted from subsurface transformation of spilled tetra- and trichloroethene, which are commonly used as industrial degreasers. This study was undertaken to determine the interactions and subsurface factors, including the microbiota and commonly used chlorinated organic solvents, which brought about these transformations. Static microcosms containing groundwater and sediments were spiked with four organic solvents (tetrachloroethene, trichloroethene, 1,1,1-trichloroethane, and tetrachloromethane) and analyzed by GC at intervals during a 16-week incubation period. Eh and pH were determined concurrently. The environmental conditions within the microcosms, i.e., neutral to acid pH and reductive potential, indicated that reductive dehalogenation was the pathway by which the observed products were formed. An aqueous milieu and the presence of electron donors and microbial mediators are believed to be influential factors. Evidently, one carbon-halogen bond in each of the solvents was ruptured to yield a compound with one fewer chlorine than its precursor. The products of transformations in microcosms were exotic compounds also found in the groundwater. They were formed only in microcosms from which living microorganisms were cultured. (Author's abstract)
W87-05631

MICROBIAL METABOLISM OF CHLOROPHENOLIC COMPOUNDS IN GROUND WATER AQUIFERS,

Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.
J. M. Suflita, and G. D. Miller.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 751-758, 1985. 5 fig, 1 tab, 16 ref. EPA Cooperative agreement CR811146-01-0.

Descriptors: *Metabolism, *Chlorophenolic compounds, *Groundwater, *Aquifers, *Biodegradation, *Fate of pollutants, Phenolics, Leachates, Microorganisms, Mineralization, Degradation, Microcosms, Substrates, Organic compounds.

The metabolism of phenol and various chlorophenols was studied in groundwater aquifer microcosms. Flow-through column microcosms containing pristine aquifer material were used to assess aerobic biodegradation processes. Reductive metabolism of the substrates was studied in serum bottles filled with aquifer material contaminated by municipal landfill leachate. We found that microorganisms present in an actively methanogenic aquifer were able to metabolize chlorophenols by replacing the halogen substituents with hydrogen atoms. The identity of the dehalogenated intermediates was confirmed by mass spectrometry for a model substrate and by cochromatography for others. Complete removal of the aryl halides was necessary before the phenol intermediate could be mineralized to methane and carbon dioxide. However, the chlorophenols tended to persist in anoxic microcosms containing material from the same aquifer but from a nonmethanogenic site. Metabolism and acclimation of chlorophenols and phenol was noted in aerobic microcosm studies, but the degradation pathway(s) were not established. (Author's abstract)
W87-05633

PHOTOOXIDANT ACTIVITY IN NATURAL WATERS,

California Univ., Davis. Dept. of Environmental Toxicology.
R. D. Ross, and D. G. Crosby.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 773-778, 1985. 2 fig, 7 tab, 22 ref. NIEHS Training grant ES-00045.

Descriptors: *Oxidation, *Natural waters, *Sterile water, *Ultraviolet radiation, *Fate of pollutants, Organic compounds, Pesticides, Tryptophan, Degradation.

After exposure to sunlight or laboratory UV light, sterilized water samples (or their reconstituted concentrates) from California and Hawaii oxidized several common environmental contaminants, including ethylenethiourea, thiobencarb, DDE and aldrin, which do not absorb ultraviolet radiation appreciably in the sunlight wavelength region. Unirradiated controls were inactive. The generated oxidant remained active in the water samples for at least 60 min in the dark at ambient temperature. Tryptophan and tyrosine were isolated as causative agents but were not the actual oxidants. Such light-induced degradation reactions have important implications for the environmental fate of chemicals in water and for environmental modelling. (Author's abstract)
W87-05635

BIOCONCENTRATION KINETICS OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN RAINBOW TROUT,

Dow Chemical U.S.A., Midland, MI. Health and Environmental Sciences.
D. R. Branson, I. T. Takahashi, W. M. Parker, and G. E. Blau.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 779-788, 1985. 2 fig, 7 tab, 22 ref.

Descriptors: *Path of pollutants, *Bioconcentration, *Bioaccumulation, *Mathematical studies, *Kinetics, *Dioxins, *Isotope studies, *Trout, *Population exposure, Fish physiology, Estimating, Growth, Radioactive half life, Depuration.

The uptake and depuration rate constants for (14C)2,3,7,8-tetrachlorodibenzo-p-dioxin (14C-TCDD) in growing rainbow trout were obtained in a laboratory experiment involving a 6-h static water uptake exposure at 107 ng/L (ppt) followed by a 139-d flow-through depuration period. Improved mathematics were developed for estimating uptake and depuration rate constants and an equilibrium bioconcentration constant that accounts for growth dilution of the total chemical body burden. The uptake and depuration rate constants for 14C-TCDD in rainbow trout (whole fish) were determined to be 108 + or - 3 ml water/g whole fish/d and 0.012 + or - 0.001/d, respectively. Based on these data, the equilibrium bioconcentration constant for TCDD, defined as the ratio of uptake to depuration rate constants, was 9,270 + or - 1,050, and the elimination half-life, t' sub 1/2, of the total body burden was 58 + or - 5 d. Clinical observations of the fish concurred with those previously reported by other researchers. (Author's abstract)
W87-05636

DECOMPOSITION BY PLANKTONIC AND ATTACHED MICROORGANISMS IMPROVES CHEMICAL FATE MODELS,

Environmental Protection Agency, Athens, GA. Environmental Services Div.
R. R. Lassiter, R. S. Parrish, and L. A. Burns.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 29-39, January 1986. 6 tab, 12 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Model studies, *Decomposition, *Plankton, *Microorganisms, *Model testing, *Aufwuchs, Prediction, Transport, Population exposure, Risk assessment, Organic compounds.

Terms for decomposition by both suspended and attached microorganisms were included in a model to calculate the fate of chemicals in aquatic systems. This model differs from previous models primarily by the inclusion of a term for decomposition by aufwuchs in addition to a term for decomposition by planktonic microorganisms. Decomposition by aufwuchs is represented as occurring at a rate limited by the serial processes of transport to a planar surface and decomposition at the surface. Two sets of experiments were conducted using replicate laboratory microcosms, each maintained with six different environments. The predictive capability was good, as indicated by the absence of statistically detectable differences between predictions and laboratory measurements. In making the predictions, a set of parameters describing the characteristics of the chemical was required. Included in these parameters were the rate coefficients for the two microbial decomposition terms. With both microbial decomposition terms included, the fate model accounted satisfactorily for observed methyl parathion concentrations using only a single, environment-independent rate coefficient for each term. (Author's abstract)
W87-05643

BIOLOGICAL HALF-LIVES OF CHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN RAINBOW TROUT (SALMO GAIRDNERI),

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Fisheries Research Branch.
A. J. Niimi, and B. G. Oliver.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 49-53, January 1986. 2 tab, 27 ref.

Descriptors: *Biological half-life, *Dioxins, *Trout, *Fate of pollutants, *Water pollution effects, Population exposure, Absorption, Organic compounds, Metabolism, Fish.

The biological half-lives of five dibenzo-p-dioxins and two dibenzofurans were determined in rainbow trout following a single oral exposure. Estimated half-lives ranged from 2 d for 2,7-dichlorodibenzo-p-dioxin to 43 d for 1,2,3,4-tetrachlorodibenzo-p-dioxin among the dioxins, and from 12 d for octchlorodibenzofuran to 24 d for 3,6-dichlorodibenzofuran. No consistent relationship was shown between half-life and the degree of chlorination. Absorption efficiencies varied from 2 to greater than 30%, although most values ranged from 5 to 16%. (Author's abstract)
W87-05644

RATION AND TOXICANT PREEXPOSURE INFLUENCE DIELDRIN ACCUMULATION BY RAINBOW TROUT (SALMO GAIRDNERI),
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
P. J. Shubat, and L. R. Curtis.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 69-77, January 1986. 3 fig, 1 tab, 25 ref. Electric Power Research Inst. Contract RP2046-1.

Descriptors: *Bioaccumulation, *Dieldrin, *Population exposure, *Trout, *Path of pollutants, *Tissue analysis, Water pollution effects, Fish growth, Diets, Lipids, Aquatic toxicology, Pesticides, Organic compounds, Isotope studies.

Whole body accumulation and tissue distribution of dieldrin in rainbow trout were studied through oral-dose disposition tests and subchronic exposures via water (0.04 and 0.08 microgram(ug) dieldrin/L) and/or diet (0.087 ug dieldrin/g fish/d). Growth and no-growth (maintenance) rations of 4 and 2% body weight per day were employed. In subchronic tests, apparent steady-state residue concentrations depended on ration and exposure concentration after 8 weeks of exposure. At 16 weeks, mean whole fish residue concentrations ranged from 120 to 1,400 ng dieldrin/g fish. Combination food and water exposures at a growth ration produced the highest accumulation to a maximum of 360 ng dieldrin/g fish. Whole body dieldrin concentration, calculated on the basis of total lipids, greatly reduced the differences in residue levels due to ration. Tissue distribution of a single oral dose of (14C)dieldrin was determined in naive (no pretreatment) fish and those preexposed via the diet for 2, 4 or 6 weeks. Tissue concentrations of the tracer dose were determined 48 h following administration. Retention of the (14C)dieldrin was similar in most tissues of naive, 2- or 6-week dieldrin-pretreated fish with a slight downward trend with duration of pretreatment. Retention of 14C in the bile of fish receiving maintenance and growth treatments increased two- and five-fold, respectively, in 6-week pretreated as compared with naive fish. After 4 weeks of pretreatment, 14C concentrations peaked in all tissues except the bile, gut, and gut contents. (Author's abstract)
W87-05646

TRACE METALS IN MUSSELS TRANSPLANTED TO SAN FRANCISCO BAY,
Moss Landing Marine Labs., CA.
D. R. Smith, M. D. Stephenson, and A. R. Flegal.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 2, p 129-138, February 1986. 5 fig, 1 tab, 22 ref.

Descriptors: *Trace metals, *Trace elements, *Mussels, *San Francisco Bay, *Path of pollutants, *Bioaccumulation, *Transplanting, Heavy metals, Pollutants.

One of the principal limitations of the initial mussel watch studies was their restricted sampling of naturally occurring indicator populations. For example, the original samples for the California mussel watch came only from areas with large mussel populations, precluding the monitoring of potentially environmentally sensitive areas lacking natural mussel populations. Mussels (Mytilus californianus) transplanted to San Francisco Bay exhibited elevated trace metal concentrations compared with those in other mussel watch studies on the west coast of the United States. The highest concentrations of Ag, Cu, Hg, Mn, Pb, and Zn were at the South Bay stations, and often in the Redwood Creek area. Ag and Hg concentrations were linearly correlated with station distance from the North Bay (San Pablo Bay), indicating that the South Bay is a major reservoir of these pollutants within San Francisco Bay. (Alexander-PTT)
W87-05650

EXHAUSTIVE STEAM DISTILLATION EXTRACTION OF AROMATIC ORGANICS FROM RAINBOW TROUT AND WATER,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 5A.
W87-05652

MICROBIAL TRANSFORMATION RATES OF AZO AND TRIPHENYLMETHANE DYES,
Gainesville Junior Coll., GA. Dept. of Biology.
G. B. Michaels, and D. L. Lewis.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 2, p 161-166, February 1986. 2 fig, 3 tab, 16 ref.

Descriptors: *Microbial degradation, *Fate of pollutants, *Azo dyes, *Biodegradation, Microorganisms, Degradation, Dyes, Transformation, Organic compounds, Bacteria.

Using field-collected and laboratory cultures, bacterial transformation rates for one azo and two triphenylmethane dyes were studied as a means of assessing the potential degradation of these compounds in aquatic environments. Transformation was measured as loss of color by spectrophotometry, and first- and second-order transformation rate coefficients were determined. Second- order coefficients (K sub b) were based on total colony-forming units (CFU) of bacteria in batch cultures. Percentages of total bacteria that transformed the dyes were determined by isolating bacterial colonies from field-collected samples and testing the isolates for the capacity to transform the dyes in dilute nutrient medium. The azo dye, Acid Orange 6, was not transformed under the aerobic conditions of these studies. Basic Violet 1 was transformed and K sub 1 values ranged from -0.003 to -0.023/h, with a mean k sub b of 3.5 x 10 to the minus 14th power L/CFU/h. Basic Violet 3 also was transformed and K sub 1 values ranged from -0.002 to -0.012/h, with a mean K sub b of 2.8 x 10 to the minus 14th power L/CFU/h. The percentage of transformer bacteria for Basic Violet 1 ranged from 6 to 28%, with a mean of 13.5%, and the range for Basic Violet 3 was 0 to 24%, with a mean of 8.32%. Therefore, the triphenylmethane dyes were transformed at similar rates, and similar fractions of the total bacterial populations were involved in the transformation. (Author's abstract)
W87-05653

MINERALIZATION AND SORPTION OF P-NITROPHENOL IN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
G. R. Siragusa, and R. D. DeLaune.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 2, p 175-178, February 1986. 3 fig, 9 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Mineralization, *Sorption, *Phenols, *Estuaries, *Sediments, Isotope studies, Organic compounds, Degradation, Toxicity, Louisiana Gulf Coast, Anaerobic conditions, Oxidation.

The sorption and mineralization of p-nitrophenol were studied in sediment from a Louisiana Gulf Coast estuary. The rate of mineralization of p-nitrophenol, as determined by 14CO2 release, was found to be several orders of magnitude faster under oxidized (aerobic) conditions than under reduced (anaerobic) conditions. The results also indicated a rapid sorption of the compound from the water column by the sediment and only minimal re-release. Due to sorption from the water columns and slow degradation of the compound in an anaerobic system, such as in bottom sediment, it is likely that this compound would persist for years in reduced estuarine sediment. (Author's abstract)
W87-05654

BIOCONCENTRATION AND DISPOSITION OF 1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN AND OCTACHLORODIBENZO-P-DIOXIN BY RAINBOW TROUT AND FATHEAD MINNOWS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, A. L. Yarechewski, A. Knoll, and G. R. B. Webster.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 261-272, March 1986. 3 fig, 5 tab, 25 ref.

Descriptors: *Bioconcentration, *Bioaccumulation, *Fate of pollutants, *Dioxins, *Isotope studies, *Metabolism, *Trout, *Minnows, *Path of pollutants, Population exposure, Depuration, Model studies, Diets, Accumulation, Elimination.

Accumulation of 14C-labeled 1,3,6,8-tetrachlorodibenzo-p-dioxin (TCDD) and octachlorodibenzo-p-dioxin (OCDD) from water by rainbow trout fry (Salmo gairdneri) and fathead minnows (Pimephales promelas) was studied using a 5-d uptake and 24 to 48-d depuration period. Average exposure concentrations ranged from 4 to 211 ng/L for 1,3,6,8-TCDD and from 9 to 415ng/L for OCDD. Equilibrium bioconcentration factors for total 14C in fish, calculated by use of a two-compartment first-order rate model, were 2,100 and 5,702 for 1,3,6,8-TCDD in trout fry and minnows, respectively, and 85 and 2,226 for OCDD in the same species. Elimination rates of both isomers were rapid, with half-lives of 14C ranging from 6 to 9 d for 1,3,6,8-TCDD and from 5 to 13 d for OCDD. The highest concentrations of radiolabeled 1,3,6,8-TCDD and OCDD were found in bile. A metabolite of 1,3,6,8-TCDD in bile was identified as a conjugate of a hydroxylated tetrachloro-derivative. Dietary exposure of rainbow trout resulted in low accumulation factors, ranging from 0.034 for OCDD to 0.018 for 1,3,6,8-TCDD, based on toluene-extractable radioactivity. (Author's abstract)
W87-05658

PROCEEDINGS OF THE ISSS SYMPOSIUM ON WATER AND SOLUTE MOVEMENT IN HEAVY CLAY SOILS.
International Society of Soil Science, Wageningen (Netherlands).
For primary bibliographic entry see Field 2F.
W87-05665

WATER AND SOLUTE MOVEMENT IN A HEAVY CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W87-05696

ANALYSIS OF SOLUTE MOVEMENT IN STRUCTURED SOILS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
J. Skopp.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 220-228, 1 tab, 5 ref.

Descriptors: *Soil water movement, *Leaching, *Solute transport, *Soil water, *Mathematical analysis, *Moments, *Path of pollutants, Data interpretation, Saturated soils, Soil columns, Flow rates, Unsaturated flow, Theoretical analysis.

The analysis of solute movement consists of several stages including conceptualization of process, development of descriptive equations, and measurement of solute movement. At some point the measurements must be reconciled with the descrip-

tive equations. Here, the movement of solutes is analyzed using moment techniques. Moments are an empirical procedure for interpreting data without bias toward a specific theory. Data for miscible displacement through packed, saturated soil columns at different flow rates is presented. Application of moment techniques to unsaturated flow conditions as well as theoretically based moments are also discussed. (See also W87-05665) (Lantz-PTT)
W87-05697

SALT TRANSPORT IN HEAVY CLAY SOIL,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
J. W. van Hoorn.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 229-240, 4 fig, 6 tab, 4 ref.

Descriptors: *Salt transport, *Soil water movement, *Leaching, *Path of pollutants, *Soil water, *Clays, Permeability coefficient, Soil profile, Soil structure, Infiltration rate, Soil aggregates, Irrigation, Desalinization, Capillary water.

Salt movement is linked together with water movement which depends on the hydraulic conductivity of a soil profile and its structure. In heavy clay soils one can usually distinguish a top layer with a rather high hydraulic conductivity consisting of the tilled layer in arable land or the turf layer in grassland, below which the hydraulic conductivity is much lower and often decreases with depth. In basin clay soils in river areas and in marine clay soils, one may encounter at a depth of about 1 m again a layer having a moderate to high hydraulic conductivity and consisting of clay with iron concretions, organic matter, peat or soil material with a coarser texture. The discharge of water in such soil profiles depends on the ratio between the rainfall (or irrigation) rate and the infiltration rate of the second layer of low permeability. Salt transport is discussed with respect to: (1) salt movement from soil aggregates to large pores; (2) leaching by the application of irrigation water; and (3) resalinization of the top layer by capillary rise. A model for predicting desalinization is also presented. (See also W87-05665) (Lantz-PTT)
W87-05698

EFFECT OF ANION EXCLUSION ON SOLUTE TRANSPORT IN SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
W. J. Bond.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 241-245, 1 fig, 1 ref.

Descriptors: *Leaching, *Soil water movement, *Path of pollutants, *Solute transport, *Anions, *Soil water, Soil chemistry, Mathematical studies, Literature review, Soil properties.

Recent findings concerning the effects of inaccessible water, and in particular concentration-dependent anion exclusion, on the location and movement of a solute front was examined for the general case of uni-dimensional, uni-directional water movement. Although several authors have shown that the presence of anion exclusion enhances the movement of solutes, few have explored the consequences of the concentration-dependence of anion exclusion. This brief review concludes that when there is anion exclusion, satisfactory calculation of the location of the solute front relies on considering the properties of both the initial and the invading solutions. (See also W87-05665) (Lantz-PTT)
W87-05699

EVALUATING A MODEL FOR NITRATE LEACHING IN CLAY SOILS WITH MACROPORES,
Oxford Univ. (England). Dept. of Agricultural Science.
R. E. White.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 246-251, 1 fig, 1 tab, 13 ref.

Descriptors: *Model studies, *Leaching, *Soil water movement, *Clays, *Nitrates, *Path of pollutants, *Soil water, Soil cracking, Soil matrix, Pore profile, Macroporosity, Pore water, Flow profile, Chlorine, Nitrogen.

Rapid breakthrough of surface-applied solutes due to preferential flow of water down macropores in cracking clay soils is well documented. The effects of this flow on the leaching of indigenous soil nitrate are more complex, depending on the ratio of macropore to matrix flow, the spatial distribution of nitrate and its rate of diffusion between the two flow domains. Outlined here is a model for nitrate leaching under unsteady flow conditions and indicates its predictive value using data from large, undisturbed soil cores. The mean fractional miscible volume in these experiments ranged from 0.12 to 0.29, and were determined from Cl(-) breakthrough data and not arbitrarily chosen as in other models. Mean NO3(-) concentrations for pairs of grassland and arable cores are plotted against drainage/pore water volumes. The change in NO3(-) concentration with drainage/pore water volumes was well simulated. Prediction of the total N leached was less accurate, being in one case too high, and in another too low. The problem, common to other models, probably lies in the measurement of the mean NO3(-) concentration in the soil initially. As well as between-core variation, NO3(-) concentration may vary by as much as 50% between the interior and exterior of peds. This aspect is being investigated further. (See also W87-05665) (Lantz-PTT)
W87-05700

SOILS AND SOLUTE PATTERNS IN RECLAIMED ESTUARINE MARSHLAND IN SOUTH-EAST ENGLAND,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 2G.
W87-05701

TRANSPORT OF SOLUTE IN HIGHLY STRUCTURED SOILS,
Laboratorium voor Grondmechanica, Delft (Netherlands).
M. Loxham.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 258-261, 3 fig, 3 ref.

Descriptors: *Soil water movement, *Solute transport, *Path of pollutants, *Soil structure, *Peat, *Soil water, Organic matter, Soil porosity, Flow profile, Model studies, Mathematical models, Sodium chloride, Hydrochloric acid, Diffusion, Protons.

Peat contains about as much organic matter as many mineral soils. However, the mineral fraction is absent and the peat has a water content of up to 98% of the sample volume. Photomicrographs of undisturbed samples and comparison of flow profile dta with particle size distributions of the (dispersed) organic matter show that most of this water is locked up in volumes largely inaccesible to the normal hydraulic flows in the profile. The water flows in large multiply connected pores and air bubbling studies show that they are continuous for at least tens of centimeters. A three phase (solid, dead zone, and active zone) model is proposed in which the active zone is assumed to consist of parallel crakcs. Convection and dispersion are considered in the crack, and molecular diffusion only in the dead zone. Transfer between the zones is by diffusion over the crack wall controlled by the diffusion rate in the dead zone. Adsorption, etc., are not considered here, but can be easily introduced. The model was tested by fitting the values of dispersion length and fissure width to the data at a higher water velocity for a NaCl case, and using it to predict the NaCl curve for lower velocities and the HCl curve. The agreement is good for the NaCl case, but for the acid case the data can only be explained by assuming either a higher effective diffusion coefficient than expected (Proton hopping) or protonation of the solid phase, both of which effects are known to occur. It can be concluded that the crack models can account for the general trends in the data in a way that the classical convection-dispersion theory cannot, and that the model gives a reasonable quantitative description of the measured breakthrough curves. (See also W87-05665) (Lantz-PTT)
W87-05702

SOLUTE DISPLACEMENT THROUGH A RENDZINA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
R. Schulin, P. J. Wierenga, and H. Fluhler.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 262-267, 1 fig, 2 tab, 6 ref.

Descriptors: *Soil water movement, *Solute transport, *Path of pollutants, *Soil water, *Mathematical models, Porous media, Model studies, Breakthrough curves, Tracer studies, Graphical analysis, Statistical analysis, Mathematical analysis, Infiltration.

Solute transport through porous media is commonly described by a convective dispersion type equation that employs a Fick-type concept of solute dispersion. This concept proved to be successful in the case of homogeneous porous media like laboratory sand packings. It failed to explain certain features of solute displacement through aggregated porous media such as the tailing of breakthrough curves (BTC). To account for these assymmetries, the original model has been extended by partitioning the liquid phase into a mobile and an immobile region. According to this model, convective-dispersive transport is restricted to the mobile region, whereas in the immobile region solute transport takes place by diffusion only. In this paper, the implications of a high skeleton content especially of coarse fragments, on the characteristics of tracer displacement are investigated. The two-region model yields an adequate fit of the data. The one-region model fails to explain the pronounced tailing of the BTC. The data support the concept of splitting the immobile water in two fractions, one in contact and the other excluded from the mobile water. Surprisingly, the mobile water content as well as the accessible immobile water content remains rather constant regardless of the total water content. Changes of water content due to variable infiltration rates seem to affect primarily the fraction of the immobile water excluded from solute transport. (See also W87-05665) (Lantz-PTT)
W87-05703

SOME THEORETICAL ASPECTS OF THE INFLUENCE OF SOIL-ROOT CONTACT ON UPTAKE AND TRANSPORT OF NUTRIENTS AND WATER,
Institute for Soil Fertility, Haren (Netherlands).
For primary bibliographic entry see Field 2G.
W87-05704

MODELLING THE INTERACTION BETWEEN SOLUTE LEACHING AND INTRA-PED DIFFUSION IN CLAY SOILS,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 2G.
W87-05706

ISSUES IN SEDIMENT RESEARCH IN RIVERS OF THE U.S.,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W87-05790

PRIORITIZING SURFACE WATER QUALITY PROBLEMS,
Agricultural Research Service, Morris, MN.
For primary bibliographic entry see Field 5G.
W87-05822

SEDIMENT-NUTRIENT TRANSPORT IN AGRICULTURAL RUNOFF,
Agricultural Research Service, Durant, OK.
For primary bibliographic entry see Field 2J.
W87-05827

EFFECT OF IMPOUNDMENTS ON NUTRIENT CONCENTRATIONS,
Agricultural Research Service, Durant, OK.
For primary bibliographic entry see Field 2H.
W87-05828

POLYCHLORINATED BIPHENYLS IN THE HOUSATONIC RIVER,
Geological Survey, Hartford, CT. Water Resources Div.
K. P. Kulp, and F. B. Gay.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 367-376, 5 fig, 6 ref.

Descriptors: *Polychlorinated biphenyls, *Housatonic River, *Massachusetts, *Connecticut, *Sediment distribution, *Path of pollutants, River sediments, Sediment transport, Suspended sediment, Dissolved oxygen, Ammonia, Nitrates, Aquifers.

Accumulations of PCB's (polychlorinated biphenyls) in the Housatonic River in Massachusetts and Connecticut are predominantly located in impounded reaches of the river where sedimentation is greatest. The highest PCB concentrations are associated with fine-grained bottom sediments. An estimated total of 10,000 kilograms of PCB's are contained in the bottom sediments, 60% of which are in Massachusetts, predominantly in a stretch of the river called Woods Pond; 40% are in Connecticut, primarily in Lakes Lillinonah and Zoar. PCB's are transported primarily in association with suspended sediment. At Great Barrington, Massachusetts, approximately 29 river kilometers below Woods Pond and 47 river kilometers below the source of the PCB contamination in Pittsfield, Massachusetts, a suspended sediment discharge of 6,400 megagrams/yr supported an estimated PCB transport of 220 kg/yr. In a sand and gravel aquifer adjacent to Woods Pond, the distribution of hydraulic heads and dissolved oxygen, ammonia, and nitrate concentrations show that industrial water supply wells have been inducing the groundwater recharge through the PCB-contaminated bottom sediments of the pond over the last 25 years. At a distance of 1.5 m from the pond's shoreline, the upper 12 m of the 32-m-thick aquifer contains water derived from induced infiltration. No PCB's were found in this vertical section at the detection limits of 0.0001 mg/L of water and 0.001 mg/kg of sediment. It is concluded that induced recharge has not moved PCB's from the bottom sediments into the aquifer 1.5 m downgradient from the edge of Woods Pond. (See also W87-05791) (Author's abstract)
W87-05829

PLOT AND WATERSHED NUTRIENT LOSSES IN THE PALOUSE,
Agricultural Research Service, Pullman, WA.
D. K. McCool, J. L. Andrews, L. F. Elliott, and R. I. Papendick.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 397-406, 1 fig, 1 tab, 21 ref.

Descriptors: *Nutrients, *Path of pollutants, *Agricultural runoff, *Palouse, *Pullman, *Washington, *Water quality, Rainfall-runoff relationships, Runoff, Nitrates, Slopes, Statistical studies, Fertilizers.

Water quality is of great concern in the Pacific Northwest. Only limited information is available on the contribution of cultivated areas to nutrients in runoff. In this study, comparison was made between soluble nutrients in runoff from a 7,019 ha watershed and adjacent research plots near Pullman, Washington. Runoff from the watershed was generally greater than from the mid-slope plots except during a concrete frost runoff event. Nitrate levels were higher from the watershed than from the plots. It was not possible to extrapolate data and relationships directly from mid-slope plots to watershed scale. Such extrapolation requires complex research and modeling techniques not within the scope of this study. (See also W87-05791) (Author's abstract)
W87-05832

CHEMICALS ASSOCIATED WITH LOWER MISSISSIPPI RIVER SEDIMENTS,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W87-05837

CCA AND PCP IN CONTAMINATED FOREST STREAM SEDIMENTS,
Southeastern Forest Experiment Station, Gainesville, FL.
D. G. Neary, R. A. LaFayette, M. A. Callaham, and P. B. Bush.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 449-458, 5 fig, 1 tab, 15 ref.

Descriptors: *Pentachlorophenol, *Copper, *Chromium, *Arsenic, *Path of pollutants, Industrial wastes, Bed load, Storm runoff, River sediments, Sediments, Deltas, Ponds, Sands.

Storm runoff from a wood-preservative plant transported copper chromium arsenic (CCA) and pentachlorophenol (PCP) into the head waters of a southern Appalachian stream system. This stream flows into a major recreation area on the Chattahoochee National Forest of North Georgia. Bedload, pond bottom, and deltaic sediments were collected quarterly for 1 year to determine seasonal levels, vertical, and horizontal distributions, and important transport processes. The stream system was sampled along a 5 km longitudinal gradient which included reaches characterized by pools and riffles, sandy bottoms, beaver ponds, artificial ponds, and lake deltas. PCP levels in sediment were low (1-3 mg/kg) in coarse bedload materials and high (10-20 mg/kg) in fine-textured pond bottom muds. CCA concentrations were similarly lower in stream bedload (< 50 mg/kg) and higher (> 50 mg/kg) in pond sediments. Both PCP and CCA were transient in normal stream reaches and accumulated in pond or deltaic sediments. (See also W87-05791) (Author's abstract)
W87-05838

NUTRIENT-SEDIMENT RELATIONS IN STREAMFLOW,
Geological Survey, Reston, VA.
R. E. Hickman.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 470-478, 4 fig, 2 tab, 5 ref.

Descriptors: *Path of pollutants, *Sediment transport, *Stream flow, *Nutrients, *Rock Creek, *Anacostia River, *District of Columbia, *Phosphorus, Suspended sediments, Kjeldahl process, Nitrogen, Seasonal variation.

Streamflow in Rock Creek and the Northwest and Northeast Branches of the Anacostia River was sampled for nutrients and suspended sediment during the 1979-81 water years. These streams are located within the Washington, D.C. metropolitan area and drain watersheds that are about half urbanized. Concentrations of total phosphorus in all three streams increase with suspended sediment concentration. The r-squared values of linear relations are 0.50 to 0.79, indicating that soil is an important source of phosphorus within the three watersheds. The proportion of total phosphorus made up by dissolved phosphorus decreases exponentially with suspended sediment concentration. Linear relations between concentrations of particulate phosphorus and suspended sediment have r-squared values 0.69 to 0.82, supporting the hypothesis that soil is an important source of phosphorus. Concentrations of total Kjeldahl nitrogen in all three streams during the months August to March increase with suspended sediment concentration. The r-squared values of linear relations are 0.52 to 0.68, indicating that soil particles are an important source of Kjeldahl nitrogen in these three watersheds. The proportion of total Kjeldahl nitrogen made up by the dissolved form shows no relation with suspended sediment concentration for any of the streams. Some high concentrations of total Kjeldahl nitrogen in the Northeast and Northwest Branches indicate sources other than soil during the months April to July. (See also W87-05791) (Author's abstract)
W87-05840

INFLUENCE OF DIFFUSE SOURCES OF CONTAMINATION ON THE QUALITY OF OUTFLOWING GROUNDWATER INCLUDING NON-EQUILIBRIUM ADSORPTION AND DECOMPOSITION,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
H. C. Van Ommen.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 79-95, November 1986. 8 fig, 15 ref.

Descriptors: *Groundwater, *Groundwater movement, *Adsorption, *Decomposition, *Path of pollutants, *Mathematical models, Continuity equations, Contamination, Concentration time, Aquifers, Transport, Solutes.

When certain conditions are met, groundwater transport of solutes originating from a diffuse source can be considered as analogous to outflow from a reservoir in which perfect mixing takes place. This theory is illustrated using three groundwater flow regimes which occur frequently: (1) flow to parallel canals, (2) flow to a fully penetrating well in a phreatic aquifer, and (3) flow to a fully penetrating well ina phreatic aquifer with a space-dependent baseflow. By deriving the mass balance for such a linearized system, the influences of several physio-chemical processes such as nonequilibrium adsorption and first order decomposition can be determined. Special attention is given to the importance of the time scale at which the processes play a role. (Author's abstract)
W87-05847

CARBON-14 AND STABLE ISOTOPE DATA FOR AN AREA IN THE MURRAY BASIN: ITS USE IN ESTIMATING RECHARGE,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
F. W. Leaney, and G. B. Allison.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 129-145, November 1986. 9 fig, 1 tab, 30 ref.

Descriptors: *Path of pollutants, *Salinity, *Aquifers, *Recharge, *Groundwater recharge, *Isotope studies, *Australia, *Saline water, *Chlorides, Solutes, Transport, Rainfall, Groundwater.

Increased salinity in the River Murray, Australia, is a major cause of concern. The major cause of the additional salt in the river is the inflow of saline groundwater. Saline groundwater inflow may be increased by land clearance which increases recharge. Because the aquifer is at a considerable depth (25-50 m) throughout much of the western part of the Murray basin, it is unlikely that there has been any response to the changed rates of recharge so far. This paper attempts to estimate the pre-clearing conditions, in order that an assement of the effect of the changed land use may be made. Measurements of the carbon 14 concentrations of water in 33 boreholes in the saline unconfined aquifer were made which showed that under natural conditions recharge falls between 0.1 and 0.2 mm per year. The chloride concentration of groundwater is log normally distributed suggesting

that its source is rainfall. The estimate of mean annual recharge to the aquifer using chloride is 0.25 mm per year. (Ram-PTT)
W87-05850

SPATIAL HETEROGENEITY OF SUBSTRATES: EFFECTS ON HYDROLYSIS, IMMOBILIZATION AND NITRIFICATION OF UREA-N,
Alberta Univ., Edmonton. Dept. of Soil Science.
C. Monreal, W. B. McGill, and M. Nyborg.
Canadian Journal of Soil Science CJSSAR, Vol. 66, No. 3, p 499-511, August 1986. 6 fig, 7 tab, 34 ref.

Descriptors: *Nutrient loss, *Fate of pollutants, *Hydrolysis, *Nitrification, *Ureas, Soil chemistry, Soil types, Ammonia, Fertilizers, Enzymes, Inhibition.

The accumulation of nitrate in soils and subsequent losses through leaching or denitrification can be reduced by retarding hydrolysis of urea and by inhibiting nitrification of ammonium-based fertilizer. Hydrolysis, immobilization and nitrification of urea-N was measured in samples of Ap horizons of a Black Chernozemic and a Luvisolic soil incubated in the laboratory. Urea was either placed as a nest or mixed throughout the soil. Samples were removed over time to determine the two-dimensional redistribution of urea, NH4(+), NO2(-), and NO3(-). Localizing urea in a nest reduced both its rate of hydrolysis and subsequent nitrification, and increased recovery of added N in the presence of straw equivalent to 4 tons/ha. In contrast, urea mixed into the soil was nearly completely hydrolyzed and oxidized in 8 d or completely immobilized in the presence of straw. Kinetic studies showed urea hydrolysis was inhibited in a Luvisolic soil sample with increasing concentration beyond 5 mM. It was concluded that nest placement of urea influenced N transformations in two ways. First, the low surface area: mass ratio reduced exposure of urea to the soil, thereby slowing processes such as immobilizations by organisms on decomposing straw. Second, at the microsite level, high concentrations of urea can inhibit urease; and NH3, once generated in such concentrated localized areas, can itself inhibit nitrification through direct toxic effects or possibly through dissolution of inhibitory organics. (Authors' abstract)
W87-05879

HEAVY METAL SPECIES, MOBILITY AND AVAILABILITY IN SOILS,
Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde.
G. W. Bruemmer, J. Gerth, and U. Herms.
Zeitschrift fuer Pflanzenernahrung und Bodenkunde ZPBOAL, Vol. 149, No. 4, p 382-398, August 1986. 7 fig, 2 tab, 50 ref.

Descriptors: *Soil analysis, *Soil chemistry, *Heavy metals, *Adsorption, Minerals, Soil water, Soil horizons, Chemical extraction, Speciation, Diffusion, Soil solution.

The ecological effects of heavy metals in soils are closely related to the content and speciation of the elements in the solid and liquid phases of soils. Methods for the determination of metal species in both phases are described and critically evaluated. In connection with the possible binding mechanisms of heavy metals in soils the concept of specific and non-specific adsorption is discussed. Recent results indicate that the adsorption of heavy metals on soil particles is not only restricted to the formation of surface complexes but can also take place in the interior of minerals. Diffusion processes of heavy metals into soil minerals are described for goethite. In order to assess metal mobility and availability in soils, the concentration and speciation of metals in the soil solution or in comparable aqueous equilibrium solutions of soil samples and the transfer of metals from solid pools to the liquid phase and vice versa have to be assessed. Methods for the determination of the amount of plant available heavy metals are described and the associated problems discussed. (Author's abstract)
W87-05888

PHOSPHORUS AND CHLOROPHYLL CONCENTRATIONS IN LAKE MONATE (NORTHERN ITALY),
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 2H.
W87-05893

EFFECTS OF SEDIMENTATION ON REMOVAL OF FAECAL COLIFORM BACTERIA FROM EFFLUENTS IN ESTUARINE WATER,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 2J.
W87-05906

5C. Effects Of Pollution

CHARACTERISTICS, TRENDS AND SURFACE WATER QUALITY IMPLICATIONS OF SALINE TILE EFFLUENT,
Department of Agriculture, Lethbridge (Alberta). Irrigation and Conservation Div.
D. B. Harker.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 325-334, 4 fig, 14 ref.

Descriptors: *Water pollution effects, *Surface water, *Water quality, *Saline water, *Alberta, *Canada, Monitoring, Effluents, Drainage, River flow, Seasonal variation, Chemical analysis, Salinity.

The possible negative impact of future saline tile effluent on river water quality within Alberta, Canada is being studied. A network of on-farm tile drainage outlets has been regularly monitored for the past six years - to establish effluent quantities, qualities and apparent trends. Based on general trends, tile drainage is not expected to impact severly on river water quality within the foreseeable future. Some short-term negative impact may occur during periods of extremely low river flow. Recently, emphasis has been placed on the variability of individual sample site data and its potential for impact on the water quality of small receiving streams. Effluent composition has considerable range among sites. Site data show effluent quality is inversely related to flow, decreasing seasonally. Long-term chemical data from individual sites has annual cycles and multi-year trends otherwise masked by site averaging. Such information indicates that site-specific data could be critical to accurately project seasonal and long-term effluent impact on small receiving systems. (See also W87-05165) (Author's abstract)
W87-05195

IMPACTS OF LIGNITE MINING ON GROUNDWATER IN TEXAS,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 4C.
W87-05243

GROUNDWATER IMPACTS OF SOLUTION MINING,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 4C.
W87-05244

HYDROELECTRIC OPERATION AT THE RIVER BASIN LEVEL: RESEARCH NEEDS TO INCLUDE ECOLOGICAL ISSUES IN BASIN-LEVEL HYDROPOWER PLANNING.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 6G.
W87-05250

COUNTING THE COSTS OF RAINFALL,
King's Coll., London (England). Dept. of Biology.
For primary bibliographic entry see Field 2B.
W87-05260

HERBICIDE EFFECTS ON WATER USE BY GRASS SOD AND RED CLOVER (TRIFOLIUM PRATENSE) ESTABLISHMENT,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
M. C. Trimmer, and D. L. Linscott.
Weed Science WEESA6, Vol. 34, No. 1, p 48-51, January 1986. 4 tab, 8 ref.

Descriptors: *Planting management, *Herbicides, *Water use, *Grasses, *Clovers, Soil water, Seeding, Oats.

Red clover was direct seeded into a grass sod after spraying with dalapon, glyphosate or paraquat. Dalapon applied a few days prior to planting did not improve red clover stands as compared to seeding in unsprayed sod. Applying glyphosate a few days before seeding in spring and summer invarably increased red clover stands, but paraquat was effective only in one of four spring or summer applications. Glyphosate applied the fall preceding a spring or summer seeding produced red clover stands superior to those after all spring treatments. Where glyphosate or paraquat was applied, water content of the upper 20 centimeters of the soil profile was greater during the first ten days after treatment in relation to unsprayed plots or those treated with dalapon. By 30 days after application, the glyphosate-treated sods used less water than those treated with paraquat. Application of glyphosate and paraquat greatly suppressed water use by oats in the greenhouse, based on water potential of the potting soil. Dalapon had little effect on water use by oat seedlings in the greehhouse. (Author's abstract)
W87-05261

PROTEIN CONTENTS OF SEED YIELDS OF FIELD-GROWN SOYBEANS EXPOSED TO SIMULATED ACIDIC RAIN: ASSESSMENT OF THE SENSITIVITIES OF FOUR CULTIVARS AND EFFECTS OF DURATION OF SIMULATED RAINFALL,
Manhattan Coll., Bronx, NY. Lab. of Plant Morphogenesis.
L. S. Evans, M. J. Sarrantonio, and E. M. Owen.
New Phytologist NEPHAV, Vol. 103, No. 4, p 689-693, August 1986. 2 tab, 10 ref. EPA Contract 1AG 81-D-X0533, DOE Contract DE-AC02-76CH00016, Associated Universities Inc. Contract 550925S.

Descriptors: *Water pollution effects, *Proteins, *Soybeans, *Crop yield, *Acid rain, *Simulated rainfall, Hydrogen ion concentration, Rainfall duration, Rainfall intensity.

Analyses of seeds harvested from field-grown soybeans demonstrated that simulated acidic rainfalls can significantly decrease total protein contents. Seed yields of plants exposed twice weekly to long duration rainfalls showed no significant differences in seed protein contents among the acidity levels tested. In contrast, significant differences in protein contents were found for seed samples from short duration daily rainfalls. Seeds from plants exposed to simulated rain of pH 5.6 had average protein contents of 37.9% compared with a range of 30.6 and 32.1% from plants exposed to lower pH values. Overall, the protein contents of seeds of acidic rainfall treatments, expressed on a per plant basis, ranged from 23 to 34%. Results suggest that the response of soybean seed yields to acidity are affected by duration and frequency of simulated rainfalls. In a second experiment, four commercial soybean cultivars were tested under conditions of longer duration rainfalls applied twice weekly. Significant treatment effects occurred for only one cultivar. The protein contents of samples from the other three were all relatively high (means were all between 35 and 39%). The relatively low protein content of the one cultivar exposed to simulated rainfalls of pH 2.7 was apparently responsible for the statistical significance among treatments. These and previous results demonstrate that rainfall acidity can significantly affect protein contents of seeds of field grown soybeans and that effects on protein

content are independent of changes in plant seed yields. (Author's abstract)
W87-05264

YIELD RESPONSE OF DAVIS SOYBEANS TO SIMULATED ACID RAIN AND GASEOUS POLLUTANTS IN THE FIELD,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Johnston, and D. S. Shriner.
New Phytologist NEPHAV, Vol. 103, No. 4, p 695-707, August 1986. 1 fig, 7 tab, 35 ref. Electric Power Research Inst. Contract 1908-2, DOE Contract DE-AC05-84OR21400.

Descriptors: *Soybeans, *Crop yield, *Acid rain effect, Simulated rainfall, *Ozone, Field tests, Air pollution, Proteins, Seeds.

The yield response of soybeans to simulated acid rain in the presence of ambient or less than ambient levels of gaseous pollution such as ozone was determined in the field. Open-top chambers were used to alter the levels of gaseous pollutants. An automatic rain simulation system was used to exclude ambient rain and apply rain simulants during natural rain events. These simulations mimicked natural rain events with respect to volume, duration, intensity and frequency. In addition, the intervals between simulated and natural rain events were the same, and therefore many of the potential experimental artifacts associated with scheduled rain simulant applications in earlier research were avoided. Variables measured in the experiment included seed, oil, protein yield, stem weight, numbers of pods and seeds and weight per seed. There were no statistically significant rain or chamber treatment effects on the measured variables except for weight per seed and protein yield. The presence of open-top chambers, when compared with plots without chambers, caused yield variables to be reduced 15 to 20%. There was no evidence to suggest that the response to rain acidity was affected by exposure to ambient or less than ambient levels of gaseous pollution. (Author's abstract)
W87-05265

EMISSION OF ETHYLENE BY OAT PLANTS TREATED WITH OZONE AND SIMULATED ACID RAIN,
Pennsylvania State Univ., University Park. Dept. of Plant Pathology.
E. J. Pell, and M. Puente.
New Phytologist NEPHAV, Vol. 103, No. 4, p 709-715, August 1986. 3 tab, 14 ref. USDA Grant 84-CSRS-2-2394.

Descriptors: *Ethylene, *Oats, *Ozone, *Acid rain effects, *Simulated rainfall, Leaves, Hydrogen ion concentration, Plant pathology.

Experiments were conducted to determine whether acid rain either exacerbated or predisposed oats to ozone injury as measured by foliar emission of ethylene. Three experiments were conducted. In the first, plants were exposed to ozone for two hours and treated for two hours with simulated acidic rain at pH 2.8, 3.8, 4.6 or 5.6. Treatments were the same in the second experiment except that only simulated acidic rain of pH 2.8 was used and larger numbers of plants per treatment were included. In the third experiment, plants were treated with simulated acidic rain of pH 2.8 for one hour and exposed to ozone the next day. At the end of each experiment, ethylene emission was determined for a pooled sample of the first and second leaf of each plant. Foliar injury was assessed 72 hours after the experiment. Acidic rain of pH 2.8 and 3.8 induced small lesions on the foliage and initiated significant increases in ethylene production. Ethylene emission was not affected by interactions between ozone and acidic rain in any of the experiments. (Author's abstract)
W87-05266

LEAF-SURFACE PROPERTIES IN RELATION TO TOLERANCE OF SALT SPRAY IN FESTUCA RUBRA SSP. LITORALIS (G. F. W. MEYER) AUQUIER,
Welsh Plant Breeding Station, Aberystwyth.
For primary bibliographic entry see Field 3C.
W87-05267

TOLERANCE OF SODIUM CHLORIDE AND ITS GENETIC BASIS IN NATURAL POPULATIONS OF FOUR GRASS SPECIES,
Liverpool Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 3C.
W87-05268

CAN WE COPE WITH SALTY WATER,
Florida Univ., Gainesville. Dept. of Ornamental Horticulture.
For primary bibliographic entry see Field 3C.
W87-05270

INTERACTIONS OF PESTICIDES WITH FRESH-WATER ALGAE: I. EFFECT OF METHOMYL AND ITS POSSIBLE DEGRADATION BY PHORMIDIUM FRAGILE,
Cairo Univ., Giza (Egypt). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W87-05276

EFFECTS OF WASTEWATER FROM OLIVE PROCESSING ON SEED GERMINATION AND EARLY PLANT GROWTH OF DIFFERENT VEGETABLE SPECIES,
Consejo Superior de Investigaciones Cientificas, Grenada (Spain). Dept. de Quimica Agricola y Fisiologia.
J. D. Perez, E. Esteban, M. Gomez, and F. Gallardo-Lara.
Journal of Environmental Science and Health JPFCD2, Vol. B21, No. 4, p 349-357, August 1986. 3 fig, 1 tab, 26 ref. C.S.I.C. Program ID-286.

Descriptors: *Water pollution effects, *Olive processing, *Wastewater, *Seeds, *Germination, *Plant growth, *Vegetable crops, Raw wastewater, Barley, Tomatoes, Deionized wastewater, Pretreatment of water, Effluents, Organic matter, Phytotoxicity.

The effects of wastewater from olive processing on seed germination and early plant growth of different vegetable species were examined. Raw wastewater, wastewater with organic matter removed and deionized wastewater were tested on species of ryegrass, tomato, green pea, bean, barley and radish at different concentrations. Results generally indicated an inhibitory effect on seed germination and early plant growth by all treatments containing any kind of wastewater. Of the three types of effluent, raw wastewater had the greatest depressive effect, followed by deionized wastewater and finally effluent with organic matter removed. Barley showed the least sensitivity to phytotoxic effects while tomato was the plant most affected. The remaining vegetable species showed an intermediate sensitivity. (Author's abstract)
W87-05277

LIVING NEAR A REFUSE DISPOSAL SITE,
Ibadan Univ. (Nigeria). Dept. of Preventive and Social Medicine.
M. A. Omishakin, and M. C. Sridhar.
Biocycle BCYCDK, Vol. 27, No. 10, p 50-51, November-December 1986. 2 ref.

Descriptors: *Waste dumps, *Nigeria, *Health effects, *Waste disposal, *Public health, Odors, Urban areas, Waste management.

A study was conducted to determine the impact of an Ibadan, Nigeria dump site on the health and living conditions of those residing in the area. The study was conducted by personal observation of the site, discussion with officials and a survey of 45 families residing near the dump site. About 400 tons of refuse are brought to the dump site daily, mostly in the form of organic waste. The major nuisances associated with the site appear to be flies, odor, smoke and mosquitoes. The Ibadan Wastes Disposal Board is too small to serve a population of two million. Lack of financing, poor working conditions for employees and climate contribute to this poor performance. The Board has not been able to plan for alternate disposal sites away from residential areas, and, as a result, refuse is piling up as the city continues to grow. Although the dump area poses health risks, residents have not tapped groundwater and a nearby stream is used more as an open sewer than as a water source. The government should periodically review existing disposal sites and should either adopt cost effective hygenic disposal methods or shift the dump sites to more remote areas. (Michael-PTT)
W87-05285

NITROGEN FIXATION IN AN OLIGOTROPHIC, SALINE DESERT LAKE: PYRAMID LAKE, NEVADA,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
For primary bibliographic entry see Field 2H.
W87-05304

EUTROPHICATION AND THE RATE OF DENITRIFICATION AND N2O PRODUCTION IN COASTAL MARINE SEDIMENTS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W87-05306

RECOLONIZATION OF MACROBENTHIC INVERTEBRATES IN A NIGERIAN STREAM AFTER PESTICIDE TREATMENT AND ASSOCIATED DISRUPTION,
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
R. Victor, and A. E. Ogbeib.
Environmental Pollution (Series A) EPEBD7, Vol. 41, No. 2, p 25-137, June 1986. 3 tab, 23 ref.

Descriptors: *Standing crops, *Macrobenthos, *Recolonization, *Midges, *Benthic fauna, *Nigeria, *Fish toxins, *Insecticides, *Stream pollution, Pesticide toxicity, Ikpoba River, Fish farming, Channel flow, Invertebrates, Naidids, Oligochaetes, Farms, Baetids, Species diversity, Recovery, Aquatic habitats, Taxonomy.

Recolonization of macrobenthic invertebrates in a tropical stream perturbed by pesticide treatment and associated human activities is discussed. The benthic community, dominated by Chironomidae, Baetidae and Naididae, was stable during the pre-disruption phase. The disruption severely reduced the standing crop and the diversity of macrobenthos. The recovery of the habitat was rapid. In spite of low diversity, high densities of invertebrates were recorded in the recolonisation phase. Naidids and chironomids were the most successful recolonisers while other groups recovered slowly. Most of the recolonising taxa occured here during the pre-disruption phase and there were only a few new colonisers. The succession of recolonising taxa was distinct. The abundance of naidids and chironomids was extremely high in the initial stages of recolonisation and thereafter decreased rapidly. (Author's-abstract)
W87-05308

CHANGES IN CARBOHYDRATE METABOLISM IN TILAPIA, OREOCHROMIS (SAROTHERODON) MOSSAMBICUS, DURING SHORT-TERM EXPOSURE TO DIFFERENT TYPES OF POLLUTANTS,
Wilson Coll., Bombay (India). Dept. of Zoology.
A. D. Dange.
Environmental Pollution (Series A) EPEBD7, Vol. 41, No. 2, p 165-177, June 1986. 4 fig, 27 ref.

Descriptors: *Fish physiology, *Tilapia, *Metabolism, *Carbohydrates, *Pollutants, *Water pollution effects, *Population exposure, Fish toxins, Mercury, Copper, DDT, Insecticides, Stress, Tissue analysis, Adaptation, Heavy metals, Hydrocarbons, Lethal limit, Sublethal effects.

During exposure of the freshwater fish, tilapia, Oreochromis (Sarotherodon) mossambicus, to heavy metals (mercury and copper), organochlor-

ine insecticides (DDT and endosulfan) and aromatic hydrocarbons (naphthalene and phenol) for up to 96 h, the lethal concentrations of all pollutants caused a substantial loss of liver and muscle glycogen. This was accompanied by a considerable rise on the plasma glucose levels. Although the sublethal concentrations generally failed to affect the tissue glycogen levels, the stress produced hyperglycemia, especially towards the end of the exposure period. The most extensive effects were produced by the aromatic hydrocarbons which, at their lethal concentrations, also caused a reduction in the liver weight by 96 h exposure. The quantitative differences in effects of the three types f pollutants are discussed in relation to differences in the capacity of fish tissues to metabolise these hazardous chemicals and also the physical activity responses of the stressed fish. (Author's abstract)
W87-05309

SYNERGISTIC EFFECTS OF ACID RAIN AND (+ OR -)-2-(2,4-DICHLOROPHENOXY) PROPANOIC ACID (2,4 DP) ON GROWTH, MINERAL CONTENT AND STRESS-INDUCED ETHYLENE IN LETTUCE,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
B. R. Larsen.
Environmental Pollution (Series A) EPEBD7, Vol. 41, No.2, p 179-196, June 1986. 6 fig, 1 tab, 43 ref.

Descriptors: *Synergistic effects, *Lettuce, *Acid rain, *Plant growth, *Simulated rainfall, *Water pollution effects, Phytotoxicity, Hydrogen ion concentration, Stress, Crop yield, Tissue analysis, Leaves, Roots, Ethylene, Aquaculture, Minerals.

Lettuce grown hydroponically in growth chambers was exposed daily for 10 days to simulated acid rain at pH 3.3, 4.1 and 5.6 with and without 1.5 mg/liter 2,4-DP. Increasing acidity reduced contents of Mn, Fe, Mg and Co, increased visible damage, but did not affect yield. Growth was stimulated by 2,4-DP at pH 4.1 and 5.6 but inhibited at pH 3.3. Contents of Zn and Co, as well as visible damage, were affected in a similar synergistic way. Contents of stress-ethylene 8 and 18 h after exposure indicated that the mode of action for synergism may be due to pH-pKa-dependent cuticular penetration. (Author's abstract)
W87-05310

CHARACTERISTICS OF HG-RESISTANT BACTERIA ISOLATED FROM MINAMATA BAY SEDIMENT,
National Inst. for Minamata Disease, Minamata (Japan). Dept. of Basic Medical Science.
K. Nakamura, T. Fujisaki, and H. Tamashiro.
Environmental Research ENVRAL, Vol. 40, No. 1, p 58-67, June 1986. 1 fig, 9 tab, 21 ref.

Descriptors: *Water pollution effects, *Mercury, *Japan, *Minamata Bay, *Sendai Bay, *Marine sediments, *Pseudomonas, *Marine bacteria, Heavy metals, Growth, Volatility, Industrial wastewater, Inorganic compounds, Organic compounds, Tolerance, Marine environment.

Seventy-two strains of Hg-resistant bacteria (Pseudomonas) were isolated on agar plates containing 40 micrograms/ml of HgCl2 from Minamata Bay sediment, which was heavily polluted with mercury (45.8 micrograms/g). The minimal inhibitory concentrations (MICs) of mercurial compounds were determined for the Hg-resistant pseudomonads and 65 strains (Pseudomonas sp., Bacillus sp., Vibrio sp., and Corynebacterium sp.) isolated from Sendai Bay Sediment (1 microgram/g of mercury) as control. The MICs to HgCl2, CH3HgCl, C2H5HgCl, C3H7HgCl, and C6H5HgOCOCH3 for the Hg-resistant pseudomonads from Minamata Bay were significantly higher than those of strains from Sendai Bay. The volatilization from liquid culture containing 20 micograms/ml of HgCl2 was observed in all of the Hg-resistant pseudo-monads from Minamata Bay (70 strains). The mean loss of mercury from liquid culture was 60.4 plus or minus 17.3%. Further study is warranted to determine what role the Hg-resistant bacteria, particularly the Pseudomonas sp., play in the mercury cycle in Minamata Bay. (Author's abstract)
W87-05312

EFFECTS OF CALCIUM AND MAGNESIUM IONS ON THE TOXICITY OF CADMIUM TO THE EGG OF THE TELEOST, ORYZIAS LATIPES,
Toyama Univ. (Japan). Biological Inst.
H. Michibata, S. Sahara, and M. K. Kojima.
Environmental Research ENVRAL, Vol. 40, No. 1, p 110-114, June 1986. 2 fig, 17 ref.

Descriptors: *Water pollution effects, *Calcium, *Magnesium, *Cadmium, *Toxicity, *Fish eggs, *Teleosts, Fish toxins, Spawning, Mortality, Hydrogen ion concentration, Ions, Fish ponds, Alkalinity, Reproduction, Heavy metals.

The effects of calcium and magnesium ions on the toxicity of cadmium to the eggs of the freshwater teleost, Oryzias latipes, were determined. Blastulae were immersed in free medium, low-Ca medium, high-Ca medium, low-Mg medium, and high-Mg medium with cadmium chloride at 10.0 mg/liter in each solution. Almost all eggs died within 24 hours in either free medium or low-Mg medium, but high-Ca medium decreased mortality remarkably: 79.9% of the eggs survived. On the other hand, there was no statistically significant difference between the cadmium content of the eggs kept in Ca-containing media and those in Mg-containing media at the corresponding molar concentrations. The present results revealed that of the two hardness constituents, calcium ions contributed to the supression of the cadmium toxicity while magnesium ions did not. (Author's abstract)
W87-05313

ULTRASTRUCTURAL CHANGES IN GILLS OF SAROTHERODON MOSSAMBICUS TREATED WITH CHICKEN MANURE,
Chinese Univ. of Hong Kong, Shatin. Dept. of Anatomy.
W. K. Liu, and M. H. Wong.
Environmental Research ENVRAL, Vol. 40, No. 1, p 164-171, June 1986. 8 fig, 1 tab, 23 ref.

Descriptors: *Tissue analysis, *Water pollution effects, *Waste disposal, *Manure, *Gills, *Fish diseases, *Fish food, Fish physiology, Growth, Yield, Activated sludge, Carp, Manganese, Copper, Zinc, Lead, Iron, Animal wastes, Diets.

Sarotherodon mossambicus were a fed a chicken manure (60%) supplementary diet for 4 weeks under laboratory conditions, and significantly higher ($P < 0.05$) concentrations of Mn, Fe, Cu, Pb, and Zn were obtained in the gills of the treated fish. Ultrastructural changes including separation of the epithelium from the pillar cell system and subsequently increasing the blood-water barrier, necrosis of lamellar cells, collapse of lamellar blood spaces, and hyperplasia of interlamellar cells were found in the lamellae of the gills of the treated fish. (Author's abstract)
W87-05314

ALGAL COMMUNITIES OF SPRINGS AND STREAMS IN THE MT. ST. HELENS REGION, WASHINGTON, U.S.A. FOLLOWING THE MAY 1980 ERUPTION,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
S. R. Rushforth, L. E. Squires, and C. E. Cushing.
Journal of Phycology JPYLAJ, Vol. 22, No. 2, p 129-137, June 1986. 3 fig, 4 tab, 43 ref. NSF Grant DEB-8021374.

Descriptors: *Water pollution effects, *Volcanoes, *Mount St. Helens, *Washington, *Diatoms, *Springs, *Streams, Algae, Fluvial sediments, Cyanophyta, Chlorophyta, Chrysophyta, Catchment areas, Stream succession, Debris, Gravity flows, Ecosystems.

Mt. St. Helens erupted violently on May 18, 1980 causing enormous damage to both terrestial and aquatic ecosystems. The initial explosion evaporated, scoured or buried all springs and streams in the blast impact area. Ash fall and erosion from defoliated hillsides subsequently filled most of the lotic habitats with organic debris and volcanic ash. Recolonization of springs and streams by algae occurred quickly in areas where erosion through the ash progressed down the bedrock. Within the 15 months or less of the eruption, algal communities were established throughout the blast impact area. However, as a result of the initial and continued disturbance these communities remained in an early successional stage. Floral assemblages were highly variable except that they were composed mostly of diatoms, with Achnanthes minutissima dominating most lotic sites. Springs showed the most rapid development toward stable floras. (Author's abstract)
W87-05315

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 1, RECOMMENDATIONS.
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 5F.
W87-05332

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 2, HEALTH CRITERIA AND OTHER SUPPORTING INFORMATION.
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 5G.
W87-05333

LOST LOONS OF THE NORTHERN LAKES,
R. Alvo.
Natural History NAHIAX, Vol. 95, No. 9, p 58-65, September 1986.

Descriptors: *Water fowl, *Reproduction, *Loons, *Water pollution effects, *Acid rain, *Lakes, *Lake acidification, Rainfall, Bird, Air pollution, Acidic water, Mortality, Environmental effects, Food habits.

Increasing acidification of northern lakes is threatening loon populations. Loons nest on the shores of lakes and are opportunistic feeders, eating fish, amphibians, crustaceans, and other freshwater and marine invertebrates as well as vegetation. A four-year study on the effects of lake acidification on loon breeding success was begun in 1982 in Ontario, where lake pH levels are as low as 4.0. It was found that healthy lakes had proportionately more successful breeding pairs than did acidic lakes; 62% of broods on acidic lakes died, while only 14% died on healthy lakes, and intermediate lakes lost 20% of the broods. It is suggested that loss of fish on acidic lakes is responsible for the low survival rate. (Doria-PTT)
W87-05337

SCHISTOSOMIASIS: A MAJOR WORLD SCOURGE WITH FEW SIGNS OF HOPE,
Hospital for Tropical Diseases, London (England). Dept. of Clinical Tropical Medicine.
For primary bibliographic entry see Field 5G.
W87-05344

PARASITE-DERIVED HAZARDS FOR CATTLE, SWINE AND POULTRY FROM WATER USED FOR DRINKING AND CLEANING PURPOSES (PARASITENBEDINGTE RISIKEN FUR RINDER, SCHWEINE UND HUHNER DURCH TRANK- UND BRAUCHWASSER),
Giessen Univ. (Germany, F.R.). Inst. fuer Parasitologie.
For primary bibliographic entry see Field 5F.
W87-05374

FACTORS AFFECTING HIGH-OXYGEN SURVIVAL OF HETEROTROPHIC MICROORGANISMS FROM AN ANTARCTIC LAKE,
Tennessee Univ., Knoxville. Inst. for Applied Microbiology.
For primary bibliographic entry see Field 2H.
W87-05393

CADMIUM- AND MERCURY-RESISTANT BACILLUS STRAINS FROM A SALT MARSH AND FROM BOSTON HARBOR,
Brandeis Univ., Waltham, MA. Rosenstiel Basic Medical Sciences Research Center.
I. Mahler, H. S. Levinson, Y. Wang, and H. O. Halvorson.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1293-1298, December 1986. 4 fig, 4 tab, 36 ref. EPA Grant R81-1702-01-0.

Descriptors: *Path of pollutants, *Water pollution effects, *Cadmium, *Mercury, *Bacteria, *Salt marshes, *Boston Harbor, *Fate of pollutants, *Toxicity, Enzymes, Heavy metals, Transport, DNA, Isolation, Harbors, Bioindicators.

Over the past decade, heavy-metal pollution of near-shore and fresh water has been increasingly recognized as a serious health problem. We are concerned with the isolation of Cd- and Hg-resistant bacteria from polluted waters, the mechanisms of their resistance, the genetic determinants involved, the transfer of resistance to sensitive microorganisms, metal-resistant bacteria as an index of a polluted environment, and the possible use of such bacteria to clean up an environment. Bacteria resistant to cadmium or mercury or both were isolated from the Great Sippewissett Marsh (Cape Cod, Mass.) and from Boston Harbor. Many of these metal-resistant isolates were gram-positive aerobic sporeformers, although not necessarily isolated as spores. Although several of the isolated strains bore plasmids, cadmium and mercury resistances appeared to be, for the most part, chromosomally encoded. DNA sequence homology of the gram-positive cadmium- and mercury-resistant isolates was not demonstrable with metal resistance genes from plasmids of either gram-positive (pI258) or gram-negative (pDB7) origin. Cadmium resistance of all the marsh isolates tested resulted from reduced Cd(2+) transport. On the other hand, three cadmium-resistant harbor isolates displayed considerable influx but no efflux of Cd(2+). Hg-resistant strains detoxified mercury by transforming Hg(2+) to volatile Hg0 via mercuric reductase. (Alexander-PTT)
W87-05395

ISOLATION OF HALOTOLERANT THERMUS SPP. FROM SUBMARINE HOT SPRINGS IN ICELAND,
Iceland Univ., Reykjavik. Biological Inst.
For primary bibliographic entry see Field 2K.
W87-05396

COMPOSITION, DISTRIBUTION AND NEUTRALIZATION OF ACID RAIN DERIVED FROM MASAYA VOLCANO, NICARAGUA,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W87-05408

EPISODIC POLLUTION - A COMPARISON OF BRIEF AND CONTINUOUS EXPOSURE OF RAINBOW TROUT TO CADMIUM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
D. Pascoe, and N. A. M. Shazili.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 3, p 189-198, December 1986. 3 fig, 4 tab, 18 ref.

Descriptors: *Water pollution effects, *Population exposure, *Comparison studies, *Rainbow trout, *Cadmium, *Toxicity, Trout fry, Heavy metals, Survival, Risk assessment, Fish, Acute exposure, Trout, Fish physiology.

Environmental quality standards and permissible emission levels for pollutants entering water are generally established by considering the results of laboratory based toxicity tests with aquatic animals, particularly fish. Almost invariably these tests, whether acute or chronic in nature, involve the continuous exposure of test animals to a fixed concentration of the chemical and the calculation of median lethal times or other response criteria under strictly controlled water quality conditions. The toxicity of cadmium to rainbow trout fry resulting from brief or continuous exposure is compared. Results of tests involving brief cadmium exposure followed by restoration to clean water indicate that postexposure mortalities may result from contact for as little as 32 min to 1.0 mg Cd/liter or 10 min to 10 mg Cd/liter. These results highlight the inadequacy of standard toxicity tests in predicting the consequences of an episodic pollution incident such as that resulting perhaps from an accidental spillage. For example, the median lethal time (LT50) following continuous exposure to 1.0 mg Cd/liter is 1900 min whereas exposure for only 32 min will ultimately result in 50% mortality. The term median postexposure lethal time (peLT50) is proposed as a means of assessing and comparing the results of brief exposure to a pollutant and it is suggested that brief or episodic exposure tests should be incorporated into the hazard evaluation process. (Alexander-PTT)
W87-05410

EFFECTS OF LONG-TERM EXPOSURE TO PENTACHLOROPHENOL ON THE FREE AMINO ACID POOL AND ENERGY RESERVES OF THE FRESHWATER AMPHIPOD GAMMARUS PSEUDOLIMNAEUS BOUSFIELD (CRUSTACEA, AMPHIPODA),
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
R. L. Graney, and J. P. Giesy.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 3, p 233-251, December 1986. 2 fig, 7 tab, 77 ref. NOAA Grant NA82RAH00002-ORD-32049.

Descriptors: *Water pollution effects, *Population exposure, *Pentachlorophenol, *Amino acids, *Amphipods, *Energy, Crustaceans, Phenols, Toxicity, Growth, Reproduction, Invertebrates, Proteins.

The presence of toxic chemicals in the aquatic environment has created the need to develop methods for assessing the potential affect of these contaminants on the health of individual organisms, populations, and/or communities. Typically this has entailed measuring long-term reproductive and growth effects and changes in community structure. Since these methods can be expensive and time consuming, the development of short-term biochemical indicators of sublethal toxicant-induced stress (BIS) has been receiving increased attention. The freshwater amphipod Gammarus pseudolimnaeus was exposed for 45 days to pentachlorophenol (PCP). The total concentration of free amino acids (FAA) decreased significantly after 5 days exposure to 0.77 or 1.25 mg PCP/liter. Exposure to PCP had no effect on the relative concentrations of individual amino acids exposed to 0.77, 1.06, or 1.25 mg PCP/liter. Whole body concentrations of glycogen, protein, and caloric content were significantly decreased after 15 days and lipid content after 30 days exposure to 0.77 mg PCP/liter. Since energy reserves and caloric content were not measured on the 5th day of PCP exposure, the relative sensitivity of FAA as a biochemical indicator of toxicant-induced stress cannot be compared directly. However, since reductions in growth and/or energy reserves can significantly influence the fecundity of amphipods, alterations in the FAA pool are indicative of future adverse effects on the organism. The use of alterations in the concentration of FAA is discussed with respect to its application as a biochemical indicator of toxicant exposure in freshwater invertebrates. (Alexander-PTT)
W87-05412

INFLUENCE OF SIZE ON ION REGULATION AND SEA-WATER SURVIVAL OF ACID-EXPOSED COHO SALMON SMOLTS (ONCORHYNCHUS KISUTCH),
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
J. F. F. Powell, and B. A. McKeown.
Comparative Biochemistry and Physiology (C), Vol. 85, No. 2, p 369-373, 1986. 1 fig, 4 tab, 22 ref.

Descriptors: *Water pollution effects, *Salmon smolts, *Salmonids, *Population exposure, *Acid exposure, *Survival, *Tolerance, *Seawater, *Ion regulation, Size, Adaptation, Coho salmon, Smolts, Fish physiology.

Evidence of a size-related influence on sea-water adaptation in salmonids has led to a concern that acid exposure prior to entry into sea-water may further influence the sea-water adaptability of smaller fish. Coho salmon smolts (Oncorhynchus kisutch) were exposed to acidified soft waters for up to three weeks. Subsamples of these fish were subjected to a sea-water challenge test after 1, 2 or 3 weeks. Larger fish were found to tolerate longer periods of acid exposure. This size-dependent survival of larger fish was further influenced as fish were subjected to a sea-water challenge test. Ion regulatory mechanisms were also shown to be related to size and duration of acid exposure. (Author's abstract)
W87-05422

COMPARATIVE STUDIES ON CHANGES IN LIPID COMPOSITION AND SOME HISTOLOGICAL RESPONSES OF GILLS FROM CARP BY EXPOSURE TO ACUTE LEVEL OF SURFACTANTS,
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
H. Nakanishi, J. Takebayashi, T. Tsuda, S. Aoki, and S. Fukui.
Comparative Biochemistry and Physiology (C), Vol. 85, No. 2, p 375-379, 1986. 5 fig, 4 tab, 14 ref.

Descriptors: *Water pollution effects, *Lipids, *Surfactants, *Carp, *Gills, *Population exposure, *Tissue analysis, Comparison studies, Fatty acids, Fish, Fish physiology, Toxicity, Histology.

A variety of surfactants have been widely used in many fields including industry, household and agriculture. Much work has been done on the toxicity of these surfactants but the evaluation of surfactants in water has been mainly investigated from a standpoint of their lethal effects to biological samples such as fish and bacterial flora and their biological degradation in aqueous environments. Carp (Cyprinus carpio) were exposed to four surfactants at the concentration of 0.02 mM (dodecylbenzenesulfonate (DBS); 7 mg/l, sodium laurylsulfonate (LNa); 5.7 mg/l, sodium stearate (SNa); 6.1 mg/l, nonylphenyl ethoxylate (EN); 13.2 mg/l). The changes in lipid composition of the gill were compared. No change in fatty acid composition of neutral lipids and complex lipids occurred after exposure to SNa, whereas changed did occur after DBS, EN and LNa. In the single case of exposure to DBS, the content of phosphatidylcholine was significantly increased as compared to control gills. The ratio cholesterol/total phospholipid and the ratio unsaturated fatty acid/saturated fatty acid were not changed after exposure to all surfactants tested. The order of gill damages was DBS > LNa > SNa > EN. (See also W87-05424) (Alexander-PTT)
W87-05423

CHANGES IN LIPID COMPOSITION AND SOME PATHOLOGICAL RESPONSES OF ROUND CRUCIAN CARP GILLS BY THE EXPOSURE TO ACUTE LEVELS OF DODECYLBENZENESULFONATE,
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
H. Nakanishi, J. Takebayashi, T. Tsuda, B. Nakagawa, and S. Fukui.
Comparative Biochemistry and Physiology (C), Vol. 85, No. 2, p 381-383, 1986. 1 fig, 2 tab, 14 ref.

Descriptors: *Water pollution effects, *Lipids, *Carp, *Gills, *Population exposure, *Acute exposure, *Dodecylbenzenesulfonate, Fish, Fish physiology, Fatty acids, Histology, Surfactants.

Although the literature contains numerous studies on the histopathological effect of a variety of substances on the gills, including heavy metals, detergent and insecticide little is available on the change in lipid composition in gills. The aim of this investigation was to study the acute effects of dodecylbenzenesulfonate on gills of round crucian carp

with emphasis on the changes in lipid composition, as well as the pathological responses. Round crucian carp (Carassius carassius grandoculis) were exposed to 7 mg/l dodecylbenzenesulfonate. All fish died within 5 hr. The greatest changes in fatty acid composition, especially polyunsaturated fatty acids of neutral lipids and complex lipids in gill, were observed. The total phospholipids were diminished, but the total cholesterol and the cholesterylester were not diminished. The epithelial walls of the secondary lamellae were broken and fused. (See also W87-05423) (Alexander-PTT)
W87-05424

ANTIOXIDANT ENZYME ACTIVITIES AND MALONDIALDEHYDE, GLUTATHIONE AND METHEMOGLOBIN CONCENTRATIONS IN CHANNEL CATFISH EXPOSED TO DEF AND N-BUTYL MERCAPTAN,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
E. Mather-Mihaich, and R. T. Di Giulio.
Comparative Biochemistry and Physiology (C), Vol. 85, No. 2, p 427-432, 1986. 4 tab, 37 ref.

Descriptors: *Water pollution effects, *Enzymes, *Catfish, *Herbicides, *Organophosphorus compounds, *Metabolism, *Population exposure, Free radicals, Toxicity, Fish, Fish physiology.

It is becoming apparent that many environmental toxicants function through free-radical or related oxidant-mediated reactions. Redox cycling of a cellular reductant, such as NADPH, with a xenobiotic results in a xenobiotic free radical. This radical species is then able to reduce molecular oxygen to oxygen-based free radicals while regenerating the original xenobiotic moiety which is capable of redox cycling again. Indicators of free-radical or oxidant-mediated responses were quantified in channel catfish, Ictalurus punctatus, exposed to the organophosphorus herbicide DEF and its metabolite, n-butyl mercaptan (nBM). The activities of the antioxidant enzymes superoxide dismutase (SOD), glutathione peroxidase (GPX) and catalase did not vary significantly with toxicant or dose. The concentrations of reduced glutathione (GSH) and malondialdehyde (MDA) did not vary significantly with toxicant or dose. The percentage of methemoglobin increased in the nBM-exposed fish with dose, up to 16.5% of total hemoglobin. The DEF-exposed catfish had no significant increases in methemoglobin compared to controls. (Alexander-PTT)
W87-05425

EFFECT OF FLUORIDE ON UPTAKE OF D-GLUCOSE BY ISOLATED EPITHELIAL CELLS OF RAT INTESTINE,
Industrial Toxicology Research Centre, Lucknow (India).
R. M. Shayiq, and A. M. Kidwai.
Environmental Research ENVRAL, Vol. 41, No. 2, p 388-399, December 1986. 10 fig, 1 tab, 33 ref.

Descriptors: *Water pollution effects, *Fluorides, *Drinking water, *Bioaccumulation, *Glucose, *Epithelial cells, Inhibition, Accumulation, Transport, Lactic acid, Sugars, Metabolism, India.

The effect of fluoride on human health stems largely from fluoride present in drinking water. In India where a large population is exposed to high fluoride levels in the water (0-0.62 mM), individuals have reached a state of balance. Inhibition on uptake of D-glucose by isolated intestinal epithelial cells (HEC) was observed when the fluoride concentration ranged between 0.25 and 5 mM. Active transport was almost completely inhibited at 5 mM. When CaCl2 was added to fluoride, the inhibitory effect on glucose uptake was abolished. Preincubation of HEC with different concentrations of fluoride (2.5-5.0 mM) for different intervals of time (2-20 min) at different pH levels (6.2-7.8) and temperatures (0-37 C) revealed that the conditions which led to higher uptake of fluoride by HEC produced maximum inhibition. The degree of inhibition was not appreciably altered by a change in glucose concentrations. A concentration-dependent effect of fluoride on lactic acid and carbon dioxide production by HEC was also observed. (Alexander-PTT)
W87-05426

EXPERIMENTAL LEAD TOXICITY IN THE RING-NECKED DUCK,
Florida Univ., Gainesville. Dept. of Physiological Sciences.
M. Mautino, and J. U. Bell.
Environmental Research ENVRAL, Vol. 41, No. 2, p 538-545, December 1986. 3 fig, 1 tab, 17 ref.

Descriptors: *Water pollution effects, *Lead toxicity, *Ducks, *Tissue analysis, *Enzymes, *Heavy metals, *Lead, Toxicity, Waterfowl.

Lead exposure has been proven to impair the enzymatic reactions of heme synthesis resulting in the elevation or excretion of intermediary metabolites. Determination of enzyme activity and quantification of metabolite concentration have been researched as a means of evaluating lead toxicosis. The determination of blood lead concentration is the reference standard for monitoring lead exposure. Ring-necked ducks (Aythya collaris) were administered a single lead shot by gastric intubation. At weekly intervals over a 7-week period, the birds were weighed and blood samples obtained for measurement of hematocrit, free erythrocyte protoporphyrin (FEP), blood lead and delta-aminolevulinic acid dehydratase (delta-ALAD) activity. The birds were fluoroscoped weekly to ensure that the pellets had been retained. Blood lead concentrations peaked 1 week after dosing at a concentration of 7.75 microgram/ml and then fell to control levels by Week 4. FEP concentrations in the treated ducks also peaked 1 week after dosing at levels which were roughly 1200% of control concentrations. The return of FEP concentrations to normal paralleled blood lead. ALAD activity was inhibited by approximately 85% by Week 1; however, there was a gradual but steady recovery of ALAD activity through Week 7. Four of the treated birds died within 2 to 3 weeks of lead administration. Physical signs of lead toxicity were maximal 7 to 10 days postdosing and included ataxia, loss of body weight, impaction of the upper gastrointestinal tract, and bile green diarrhea. In surviving birds, overt signs of toxicity declined with time and all birds appeared normal by Week 7. (Alexander-PTT)
W87-05427

IMPACT OF PHOSPHAMIDON ON THE CARBOHYDRATE METABOLISM OF A FRESHWATER PRAWN, MACROBRACHIUM LAMARREI,
Gorakhpur Univ. (Inida). Pollution Relevant Research Lab.
Omkar, V. B. Upadhyay, and G. S. Shukla.
Environmental Research ENVRAL, Vol. 41, No. 2, p 591-597, December 1986. 1 tab, 37 ref.

Descriptors: *Phosphamidon, *Water pollution effects, *Prawns, *Crustaceans, *Carbohydrates, *Metabolism, *Tissue analysis, *Bioassay, Pesticides, Toxicity, Sugars, Population exposure.

Growing awareness of the environmental pollution by organochlorinated pesticides increased the utilization of organophosphorus and carbamate compounds. But as a consequence of their excessive use in agriculture and public health, these compounds cause the contamination of water bodies and thus create hazards to the nontarget aquatic organisms. Bioassay tests have shown the compounds to be very toxic to aquatic organisms including various species of crustaceans. The effects of a lethal (96 hr LC50) and two sublethal (40 and 80% of 96 hr LC50) doses of phosphamidon on hepatic and muscle glycogen values and blood glucose level of a freshwater prawn, Macrobrachium lamarrei (H. Milne Edwards) were studied. Pesticide exposure depleted the glycogen values in both tissues while the blood glucose level was elevated up to 72 hr, after which it was decreased. The probable explanations of phosphamidon-induced changes are discussed. (Alexander-PTT)
W87-05428

CHRONIC EXPOSURE TO ALDICARB-CONTAMINATED GROUNDWATER AND HUMAN IMMUNE FUNCTION,
Centers for Disease Control, Atlanta, GA. Epidemiology Program Office.
M. C. Fiore, H. A. Anderson, R. Hong, R. Golubjatnikov, and J. E. Seiser.
Environmental Research ENVRAL, Vol. 41, No. 2, p 633-645, December 1986. 1 fig, 6 tab, 17 ref.

Descriptors: *Water pollution effects, *Population exposure, *Chronic exposure, *Aldicarb, *Groundwater pollution, *Human immune function, Pesticides, Carbamates, Antigens, Immunodysfunction, Wisconsin, Groundwater.

Aldicarb, a carbamate insecticide-nematocide, has been used extensively in the United States and throughout the world since its introduction in the 1960s. In its pure form, this highly water-soluble pesticide is extremely toxic with a reported LD50 of about 1 mg/kg in mice. In the environment, aldicarb is rapidly degraded into its major metabolites aldicarb sulfoxide and sulfone. Aldicarb has not been reported to bio-accumulate in the environment or in humans. Aldicarb has been a known groundwater contaminant in Wisconsin since 1981. To asses the effects of chronic ingestion of low-level aldicarb-contaminated groundwater (< 61 ppb) on the immune function of humans, we identified 50 women, ages 18 to 70, with no known underlying reason for immunodysfunction. Twenty-three of these women (exposed group) consumed groundwater with detectable levels of aldicarb, and 27 (unexposed group) consumed water from a source with no detectable levels of aldicarb. Data were collected on each woman's health status, immune function, and fluid intake. Exposed women as compared with unexposed women showed an elevated stimulation assay response to the antigen Candida ($P < 0.02$, t test). The exposed group had increased numbers of T8 cells ($P < 0.05$, t test), an increased percentage of total lymphocytes as T8 cells ($P < 0.02$, t test), and a decreased ratio of T4:T8 cells ($P < 0.02$, t test). Our results suggest an association between consumption of aldicarb-contaminated groundwater and abnormalities in T-cell subsets in women with otherwise intact immune systems. (Alexander-PTT)
W87-05429

STRONG PROBABILITY OF LETHAL TOXICITY IN THE BLUE-GREEN ALGA MICROCYSTIS VIRIDIS LEMMERMANN,
Tokyo Metropolitan Research Lab. of Public Health (Japan).
M. F. Watanabe, S. Oishi, Y. Watanabe, and M. Watanabe.
Journal of Phycology JPYLAJ, Vol. 22, No. 4, p 552-556, December 1986. 2 fig, 2 tab, 20 ref.

Descriptors: *Algal blooms, *Algae, *Water pollution effects, *Toxicity, *Cyanophyta, *Microcystis, *Eutrophication, Cultures, Public health, Water management.

Occurrences of bloom-forming toxic blue-green algae have been reported in many countries of the world. The greatest attention has been paid to Microcystis aeruginosa due to its common and cosmopolitan occurrence and lengthy period of dominance. Lethal toxicity (intraperitoneal, mouse) was examined in relation to species composition of samples containing bloom-forming Microcystis populations from natural waters and correlated with toxicity of laboratory strains of four Microcystis formas and species. Toxicity was not always associated with the presence of M. aeruginosa f. aeruginosa Elenkin. A sample with almost all cells of M. aeruginosa f. aeruginosa showed no toxicity. However samples comprised of a high percentage of M. viridis Lemmermann often showed lethal toxicity. Toxicity tests were done on culture strains M. aeruginosa f. aeruginosa, M. aeruginosa f. flow-aquae Elenkin, M. viridis and M. wesebergii Komarek. All five cultured strains of M. viridis were found to be toxic, while only one out of nine strains of M. aeruginosa f. aeruginosa was toxic. Six strains of M. wesenbergii showed no toxicity. It is recommended that attention should be paid to the occurrences and possibility of toxic blooms of M. viridis from the stand-

point of water management and public health. (Alexander-PTT)
W87-05482

ROLE OF ALKALINE PHOSPHATASE IN THE SEDIMENTS OF VENICE LAGOON ON NUTRIENT REGENERATION,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
D. Degobbis, E. Homme-Maslowska, A. A. Orio, R. Donazzolo, and B. Pavoni.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 4, p 425-437, April 1986. 5 fig, 5 tab, 30 ref. EEC Grant ENV-513-IS; CNR Grant 83.02434.03.

Descriptors: *Alkaline phosphatase, *Eutrophication, *Water pollution effects, *Water pollution sources, *Sediments, *Cycling nutrients, *Enzymes, Venice Lagoon, Interstitial water, Adriatic Sea, Seawater, Phosphorus, Nutrients, Lagoons, Regression analysis, Italy.

The fast development of various human activities (industry, agriculture, port, tourism) during the last few decades has caused eutrophication in Venice Lagoon, a 550 sq km marine embayment of the northwestern Adriatic Sea. Due to its shallowness (average depth about 0.6 m), nutrient exchange at the sediment-water interface can be expected to play an important role in the eutrophication processes of the lagoon. It is essential to understand the mechanisms of nutrient regeneration in the sediments and the release patterns to overlying water. Potential alkaline phosphatase activity and nutrient concentrations were determined in the seawater, interstitial water and sediments of the most polluted area in the Venice Lagoon, at 6 stations, during three cruises performed in the October/November 1982 period, when a minimum phytoplankton standing crop existed. The relationships between parameters were established by linear regression analysis. The results clearly indicate the important role of alkaline phosphatase (APA) in phosphorus regeneration. Indeed, APA appears to be a good indicator of the degree of nutrient regeneration occurring in surface sediments on a global basis. In the Venice Lagoon a significant nutrient release from the sediments to the overlying lagoon water takes place. This process appears to be at least as important as external contributions in both establishing and controlling the concentration of the nutrients in lagoon waters. (Alexander-PTT)
W87-05486

TOXICITY OF NITRITE TO FISH: A REVIEW,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, and D. F. Morris.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 2, p 183-195, March 1986. 3 tab, 55 ref.

Descriptors: *Water pollution effects, *Toxicity, *Nitrites, *Reviews, *Fish physiology, Bioaccumulation, Chlorides, Calcium, Cations, Temperature effects, Gills, Fish, Anoxia, Salmonids, Bicarbonates.

Nitrite, an intermediate in the oxidation of ammonium to nitrate, changes hemoglobin to methemoglobin, which does not carry oxygen; nitrite may thus cause anoxia in fish and other aquatic organisms. The published literature on nitrite toxicity to fish, which consists of about 40 papers, shows that the ratio of the 24-h LC50 to the 96-h LC50 has a median value of 2.0 and is fairly uniform across species; toxicity tests of differing duration can therefore be standardized to a common duration. In general, chronic effects are difficult to detect at concentrations below one-fifth of the 96-h LC50. Most fish concentrate nitrite in fresh water; chloride in the external environment offsets the toxicity of nitrite by competing with nitrite for uptake through the chloride cells of the gills. The strength of the chloride effect is greatest for the least-sensitive species and smallest for the most-sensitive species. The addition of 1 mg/L chloride increases the 96-h LC50 by 0.29 to 2.0 mg/L nitrite-N, depending on the species. Bicarbonate also reduces the toxicity of nitrite, but much less than chloride; the effects of other metal cations have not been studied. Hydrogen ion concentration of the medium has not been shown to have a discrete effect on the toxicity of nitrite except at extreme concentrations uncharacteristic of the environments in which fish ordinarily live. Nitrite toxicity is exacerbated by low oxygen concentrations because nitrite reduces the oxygen-carrying capacity of the blood. The effects of temperature have not been adequately studied. Very small fish seem less sensitive to nitrite than fish of intermediate or large size. Present evidence suggests that salmonids are among the fishes most sensitive to nitrite; channel catfish Ictalurus punctatus, blue tilapia Tilapia aurea, logperch Percina caprodes, and brook stickleback Culaea inconstans are equally sensitive or slightly less sensitive. The fathead minnow Pimephlaes promelas, other cyprinids, catostomids, the mottled sculpin, Cottus bairdi, and the black bullhead Ictalurus melas are considerably less sensitive. The least-sensitive species tested thus far are the largemouth bass Micropterus salmoides and bluegill Lepomis macrochirus; the largemouth bass does not concentrate nitrite. (Author's abstract)
W87-05492

CHRONIC TOXICITY OF AMMONIA TO FATHEAD MINNOWS,
Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. V. Thurston, R. C. Russo, E. L. Meyn, R. K. Zajdel, and C. E. Smith.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 2, p 196-207, March 1986. 5 fig, 8 tab, 17 ref. EPA Research grants R800861, R803950 and CR807240.

Descriptors: *Water pollution effects, *Toxicity, *Ammonia, *Fish physiology, *Population exposure, *Fish growth, Survival, Reproduction, Histopathology, Fish eggs, Hatching, Fish larvae.

Chronic effects of ammonia on the fathead minnow Pimephales promelas were studied in the laboratory in two flow-through tests, each test lasting approximately 1 year. Fish were exposed to five test concentrations over the range 0.07-0.96 mg/L un-ionized ammonia (NH_3); the mean pH of the test water was 8.0, and the mean temperature was 24.2 C. The tests started with 3- to 5-d-old larvae that were reared to sexual maturity; progeny of these fish (F1) were reared until they were 60 d old. The 5% probability level was chosen to indicate significance. No effects were observed on growth or survival of parental fish at 0.44 mg/L NH_3, or on egg production or viability at 0.37 mg/L, but effects on all of these were observed at 0.91 mg/L. Growth and survival of F1 larvae were not affected at 0.36 mg/L NH_3, which was the highest concentration at which these were tested. Egg hatching success was not affected at 0.19 mg/L NH_3, but was at 0.37 mg/L. Brain lesions were common in parental fish at all stages of development at exposure concentrations of 0.21 mg/L NH_3 and higher, but not at 0.11 mg/L; no other histopathologic effects were observed at any of the test concentrations. The chronic-effects threshold concentration, based on survival, growth, and reproductive success, is estimated to be 0.27 mg/L NH_3 for the conditions of these tests. Based on histological damage, however, this concentration is estimated to be 0.15 mg/L NH_3. (Author's abstract)
W87-05493

EFFECTS OF HIGH TISSUE CONCENTRATIONS OF SELENIUM ON REPRODUCTION BY BLUEGILLS,
Ohio State Univ., Columbus. Dept. of Zoology.
R. B. Gillespie, and P. C. Baumann.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 2, p 208-213, March 1986. 1 fig, 6 tab, 21 ref.

Descriptors: *Water pollution effects, *Selenium, *Tissue analysis, *Reproduction, *Bluegills, *Fish physiology, *Reservoirs, Fish larvae, Mortality, Fish eggs, Hatching, Fish populations, Hyco Reservoir, Roxboro City Lake.

Recent studies have associated high body concentrations of selenium with declines in fish populations inhabiting cooling reservoirs of coal-fired electric power plants. Because some evidence indicated that these declines resulted from reduced reproduction, we made a series of 18 artificial crosses of bluegills Lepomis macrochirus possessing high and low body concentrations of Se to determine whether elevated Se in parents reduced viability of gametes or increased mortality of embryos and larvae. Bluegills with high body concentrations of Se were obtained from Hyco Reservoir (cooling water source of a coal-fired power plant) and those with low body concentrations were obtained from nearby Roxboro City Lake, North Carolina. Neither percent fertilization nor percent hatch of eggs differed significantly among the parent combinations. However, all crosses (8) that included females with high Se body concentrations resulted in larvae with edema; such larvae did not survive to the swim-up stage. Only one of these crosses produced some normal larvae (35%). Mean Se concentrations in the gonads and carcass (body minus gonad) were more than 20 times higher in bluegills from Hyco Reservoir (average = 7.94 mg/kg) than in those from Roxboro City Lake (average = 0.38 mg/kg). The high Se concentrations in ovaries of Hyco Reservoir bluegills and in their progeny suggested that Se was transferred from females to offspring and caused edema in larvae. This abnormality resulted in mortality of affected larval bluegills-and consequently may have caused reductions in the bluegill populations of selenium-enriched reservoirs. (Author's abstract)
W87-05494

EFFECTS OF FIVE METALS ON SUSCEPTIBILITY OF STRIPED BASS TO FLEXIBACTER COLUMNARIS,
Rockland Community Coll., Suffern, NY.
R. D. MacFarlane, G. L. Bullock, and J. J. A. McLaughlin.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 2, p 227-231, March 1986. 1 fig, 1 tab, 14 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Striped bass, *Flexibacter, *Fish diseases, *Fish pathology, *Infection, Susceptibility, Protection, Population exposure, Arsenic, Cadmium, Copper, Lead, Selenium, Toxicity.

Because stocks of striped bass Morone saxatilis along the middle Atlantic coast have declined steadily, research has been undertaken during recent years to identify factors affecting survival of this species. Exposure of young striped bass Morone saxatilis (weight, 8.5-34 g) to a mixture of arsenic, cadmium, copper, lead, and selenium at 4 and 10 times the average environmental concentrations of 1-3 microgram/L protected the fish from experimental infection with Flexibacter columnaris, the causal organism of columnaris disease. In four trials, all striped bass died within 7 d after a 2-min exposure to 5000000 F. columnaris cells in untreated water. In contrast, no fish died after a single day's exposure to the metal mixture followed by infection with F. columnaris and a second exposure to the metals for seven more days. When striped bass were exposed 5 d to individual metals, copper protected against infection and cadmium offered marginal protection but was slightly toxic after 2 d exposure. Arsenic increased susceptibility to infection, and lead and selenium were without an apparent effect. (Alexander-PTT)
W87-05496

FECUNDITY AND TRACE-METAL CONTENT OF CREEK CHUBS FROM A METAL-CONTAMINATED STREAM,
Ohio State Univ., Columbus. Environmental Biology Program.
R. J. Reash, and T. M. Berra.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 2, p 346-351, March 1986. 2 fig, 2 tab, 20 ref. Army COE Contract DACW69-83-M-0698.

Descriptors: *Water pollution effects, *Creek chubs, *Reproduction, *Trace metals, *Tissue analysis, *Stream pollution, *Bioaccumulation, Toxicity, Fish physiology, Ohio, Field tests, Heavy metals, Bioavailability, Streams, Fish.

Creek chubs Semotilus atromaculatus from a metal-contaminated stream and a nearby clean stream in Richland County, Ohio, were studied to define the effects of chronic urban pollution on fecundity and tissue metal concentrations. Polluted waters had higher concentrations of total Cr, Cu, Fe, Ni, and Zn than control stream samples. Mean whole-body concentrations of Cr (5.3 microgram(ug)/g dry weight) and Zn (166 ug/g) were significantly higher ($P < 0.05$) in fish from polluted sites than in fish from some control stream segments, but these differences were much less than differences in total metal concentrations at the respective sites, indicating little metal uptake by the fish, and probably low bioavailability of the metals. Fecundity of creek chubs was similar at polluted and control sites. Fecundity may not be a good gauge of toxicant stress, at least for creek chubs, but this study points up the need to distinguish between total metals and those that are in a biologically available form when field studies of pollution are conducted. (Author's abstract)
W87-05498

DETERMINATION OF GENOTOXIC POLYCYCLIC AROMATIC HYDROCARBONS IN A SEDIMENT FROM THE BLACK RIVER (OHIO),
Brigham Young Univ., Provo, UT. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-05499

IN VITRO METABOLISM AND IN VIVO BINDING OF BENZO(A)PYRENE IN THE CALIFORNIA KILLIFISH (FUNDULUS PARVIPINNIS) AND SPECKLED SANDDAB (CITHARICTHYS STIGMAEOUS),
University of Southern California, Los Angeles. Dept. of Pathology.
E. von Hofe, and H. W. Puffer.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 15, No. 3, p 251-256, 1986. 3 tab, 42 ref.

Descriptors: *Water pollution effects, *Coastal waters, *Benzo(a)pyrene, *Killifish, *Sanddabs, *Carcinogens, *Hydrocarbons, *Pathogens, Health hazards, DNA, Estuaries, Toxicity.

Aquatic species in the nearshore environment are exposed to potentially carcinogenic and toxic hydrocarbon pollutants. The pathogenic activity of many of these hydrocarbons is frequently dependent upon host metabolic activation and deactivation patterns. To better understand the potential hazard of these substances to aquatic species, the in vitro metabolism and in vivo binding of the ubiquitous hydrocarbon pollutant benzo(a)pyrene (BaP) were studied in an estuarine fish (Fundulus parvipinnis) and in a benthic marine fish (Citharicthys stigmaeous) and compared to BaP metabolism and binding in mice. While significant amounts of the proximate carcinogen 7,8-dihydro-7,8-dihydroxybenzo(a)pyrene were produced by the hepatic microsomes of both fish species, total binding of BaP to hepatic DNA in vivo was significantly less in both aquatic species compared to hepatic DNA binding in C57B1/6J mice. The binding of BaP to hepatic proteins of C. stigmaeous, however, was greater than its binding to proteins in C57B1/6J mice. These findings suggest that this fish may be more resistant than mammalian species to the carcinogenic effects of BaP, but that they may be more sensitive to a variety of toxic effects potentially more damaging to a species than cancer which are also caused by polycyclic aromatic hydrocarbons. (Author's abstract)
W87-05500

INTERACTION OF BENZO(A)PYRENE AND CADMIUM ON GSH-S-TRANSFERASE AND BENZO(A)PYRENE HYDROXYLASE IN THE BLACK SEA BASS CENTROPRISTIS STRIATA,
National Marine Fisheries Service, Charleston, SC. Charleston Lab.
P. H. Fair.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 15, No. 3, p 257-263, 1986. 4 fig, 39 ref.

Descriptors: *Water pollution effects, *Benzo(a)pyrene, *Cadmium, *Synergistic effects, *Black sea bass, *Enzymes, *Tolerance, Hydrocarbons, Heavy metals, Xenobiotics, Monitoring.

Assessing the effects of simultaneous exposure of marine animals to multiple contaminants is particularly important because of the increasing diversity of contaminants in the marine environment. The effect of benzo(a)pyrene (BaP) and cadmium (Cd) upon the hepatic enzymes, BaP hydroxylase and GSH-S-transferase, was investigated in black sea bass. Intraperitoneal (ip) injections of BaP produced a significant increase in BaP hydroxylase activity in the microsomal fraction and GSH-S-transferase activity in the cytosol. Administration of Cd alone had no effect on either enzyme. However, when both Cd and BaP were injected (ip) in the fish, Cd had an inhibitory effect on the activity of these hepatic enzymes. Pretreatment of fish with a low dose of Cd (0.42 mg/kg) prior to injection of BaP and Cd produced a 30% increase in GSH-S-transferase activity and a 50% reduction in BaP hydroxylase activity when compared to fish injected with BaP alone following Cd pretreatment. Thus, a low dose of Cd was effective in producing a tolerance to a subsequent Cd challenge for the enzyme GSH-S-transferase but not for BaP hydroxylase. In contrast, fish pretreated alone or with Cd displayed no difference in either enzyme activity. The implications from this study on the exposure of black sea bass to two xenobiotics, Cd and BaP, indicate that BaP hydroxylase may not serve as a good monitor for hydrocarbon pollution in the presence of Cd. (Alexander-PTT)
W87-05501

ATRAZINE UPTAKE, PHOTOSYNTHETIC INHIBITION, AND SHORT-TERM RECOVERY FOR THE SUBMERSED VASCULAR PLANT, POTAMOGETON PERFOLIATUS L.,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
T. W. Jones, W. M. Kemp, P. S. Estes, and J. C. Stevenson.
Archives of Environmental Contamination and Toxicology AECTCV, Vol. 15, No. 3, p 277-283, 1986. 4 fig, 3 tab, 24 ref. EPA Grant X0032 48010.

Descriptors: *Water pollution effects, *Path of pollutants, *Bioaccumulation, *Atrazine, *Photosynthesis, *Submerged plants, *Inhibition, *Recovery, Population exposure, Oxygen, Chesapeake Bay, Herbicides, Weed control, Agriculture, Potamogeton.

A small percentage of the herbicides used for agricultural weed control is lost from croplands with some eventually entering contiguous watercourses. The processes of atrazine (2-chloro-4-(ethylamino)-6-(isopropylamino-)-s-triazine) uptake and release in the submersed vascular plant, Potamogeton perfoliatus L., were rapid, approaching equilibrium with the surrounding environment within one hr. The ratio of internal atrazine concentration to external concentration was approximately 10 at the point of maximum photosynthetic inhibition and rapidly increased at lower external atrazine concentrations. The I50 (the concentration inhibiting photosynthesis by 50%) for atrazine in solution was 80 microgram(ug)/L with the maximum observed photosynthetic reduction (87%) at a solution concentration of 650 ug/L. Initial photosynthetic recovery of P. perfoliatus following exposure to atrazine was rapid with oxygen evolution from treated plants (5, 25, and 100 ug/L) being statistically indistinguishable from control plants after two hr of atrazine-free wash. However, there was an indication of residual photosynthetic depression in dosed plants, even after a 77 hr recovery period. In Chesapeake Bay, potential long-term exposure of submersed plants to concentrations of atrazine greater than 10 ug/L is doubtful so that reduction of P. perfoliatus photosynthesis under such conditions would be minimal and reversible. (Alexander-PTT)
W87-05502

EFFECTS OF SALINE WATER IRRIGATION ON SOIL SALINITY, PECAN TREE GROWTH AND NUT PRODUCTION,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
S. Miyamoto, T. Riley, G. Gobran, and J. Petticrew.
Irrigation Science IRSCD2, Vol. 7, No. 2, p 83-95, 1986. 4 fig, 6 tab, 12 ref.

Descriptors: *Impaired water use, *Water pollution effects, *Saline soils, *Irrigation effects, *Pecan trees, *Crop yield, *Salinity, *Salt tolerance, Cultivation, Irrigation, Salts, Orchards, Accumulation, Leaching, Tree growth, Soil types, Irrigation management.

Irrigated cultivation of pecans (Carya illinoensis K.) has increased dramatically in the Southwestern USA, yet their tolerance to salinity remains largely unknown. A study was conducted to assess if stunted tree growth reported in clayey soils is related to salinity, and to evaluate changes in soil salinity and the performance of 11 year old 'Western' trees irrigated with water of 1.1 dS/m and 4.3 dS/m for 4 years. The study showed a highly significant correlation between tree trunk size and salinity of the saturation extract (EC sub e) with r = -0.89. Soil salinity above which truck size decreased in excess of the standard error was 2.0 dS/m in EC sub e from 0-30 cm depth, and 3.0 dS/m in 0 to 60 cm depth with corresponding Na concentrations of 14 and 21 mmol/L. Excessive accumulation of salts and Na was found only in silty clay and silty clay loam soils. Irrigation with waters of 1.1 and 4.3 dS/m increased EC sub e of the top 60 cm profile from 1.5 to 2.2 and 4.2 dS/m and Na concentration in the saturation extract to 17 and 33 mmol/L, respectively. The leaching fractions were estimated at 13 and 37% when irrigated with waters of 1.1 and 4.3 dS/m, respectively. Tree growth progressively slowed in the saline plots irrigated with water of 4.3 dS/m, and became minimal during the 4th year. The cumulative shoot length over the 4 year period was reduced by 24% and trunk diameter by 18% in the saline plots relative to nonsaline plots. Irrigation with the saline water also reduced nut yields by 32%, nut size by 15% and leaflet area by 26% on the 4 year average, indicating that pecans are only moderately tolerant to salinity. The concentration of Na, Cl and Zn in the middle leaflet pair did not differ significantly between the two treatments. Soil salinity provided a more reliable measure for assessing salinity hazard than leaf analysis. However, soil salinity was found to be highly spatially variable following a normal distribution within a soil type. This high variability needs to be recognized in soil sampling as well as managing irrigation. (See also W87-05507) (Author's abstract)
W87-05506

SEEDLING MORTALITY OF SEVERAL CROPS INDUCED BY ROOT, STEM OR LEAF EXPOSURE TO SALTS,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
S. Miyamoto, K. Piela, and J. Petticrew.
Irrigation Science IRSCD2, Vol. 7, No. 2, p 97-106, 1986. 6 fig, 2 tab, 16 ref.

Descriptors: *Water pollution effects, *Seedlings, *Mortality, *Food crops, *Salinity, *Irrigation, Guayule, Carrots, Chile peppers, Tomatoes, Soil columns, Accumulation, Temperature effects, Humidity, Accumulation, Emergence.

Seedling mortality caused by excessive salinity is common in establishing furrow-irrigated crops. The processes involved and salinity levels leading to seedling mortality in guayule (Pathenium argentatum Gray cv. 593), carrot (Daucus carota L. cv. Imperator-58), chile pepper (Capsicum annuum L. cv. New Mex. 6-4), and tomato (Lucopersicon esculentum Mills cv. Rutgers) were evaluated. Salt accumulation patterns were also evaluated in soil columns subirrigated with waters of 0.8 and 3.9 dS/m. Seedlings were first grown for 10 to 16 days

in greenhouse pots with water of 0.8 dS/m. Upon emergence of the first true leaf, seedling roots, leaves and stems were independently exposed to different levels of salinity (0.8 to 59 dS/m) under two diurnal temperature regimes (22-32 C and 24-40 C). When seedling roots were exposed to the saline solutions, mortality was substantially greater under the high temperature, and increased greatly at salinity levels of soil solutions exceeding about 5 dS/m in guayule and carrot, and 15 dS/m in tomato and pepper. Mortality caused by leaf exposures to saline spray was greater under the low temperature with higher relative air humidities, and increased greatly when salinity levels of spray solutions exceeded approximately 5, 10, 15 and 20 dS/m in guayule, carrot, tomato and pepper, respectively. Physical abrasion of seedling leaves prior to saline water spraying significantly increased mortality. Stem exposure to a thin layer of salted sand having the saturation extract salinity of up to 58 dS/m caused no significant increase in mortality. Soluble salts were accumulated mostly in a soil depth of 0 to 0.5 cm at a rate of 35 dS/m in 3 weeks when subirrigated with water of 3.9 dS/m. Under furrow-irrigated conditions, seedling mortality may be induced mainly through leaf and/or root, but not stem, exposure to the salts accumulated at soil surfaces. Leaf-induced mortality can be the most significant process when wind-damaged seedlings are exposed to saline spatters during light showers common to the semi-arid region. (See also W87-05506) (Author's abstract)
W87-05507

FLUORIDE ADSORPTION BY A SALINE SODIC SOIL IRRIGATED WITH A HIGH F WATER,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 5B.
W87-05508

WASTEWATER DISINFECTION AND INFECTIOUS DISEASE RISKS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W87-05548

HISTOPATHOLOGICAL AND ULTRASTRUCTURAL CHANGES IN THE GILLS OF POECILIA RETICULATUS INDUCED BY AN ORGANOCHLORINE PESTICIDE,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
M. T. Virtanen.
Journal of Environmental Pathology, Toxicology and Oncology JEPOEC, Vol. 7, No. 1/2, p 73-86, September-December 1986. 9 fig, 1 tab, 19 ref.

Descriptors: *Population exposure, *Water pollution effects, *Histopathology, *DDT, *Guppies, *Fish pathology, Histology, Cells, Electron microscopy, Light microscopy, Ultrastructure, Pesticides, Organochlorine compounds, Organic compounds, Gills.

After exposure to 1.2-3.0 part per billion (ppb) DDT in an aquatic-terrestrial model ecosystem, the gills of guppies showed histopathological changes when examined by light and electron microscopy. The secondary lamellae of the gills were shortened and deformed and the epithelial cells were disoriented with regard to the pillar cell system. In many places erythrocytes were virtually absent from the blood laguna, which was filled with the flanges of pillar cells. The microfilament bundles in the pillar cell cytoplasm had disintegrated. The chloride cells were swollen and alterations had occurred in their mitochondria and nuclei. The changes did not resemble the typical non-specific pattern of pesticide poisoning and probably were specific to DDT. (Author's abstract)
W87-05554

CANCER MORTALITY AND THE METHOD OF CHLORINATION OF PUBLIC DRINKING WATER: ST. LOUIS CITY AND ST. LOUIS COUNTY, MISSOURI,
Missouri Univ.-Columbia. Environmental Health Surveillance Program.
For primary bibliographic entry see Field 5F.
W87-05555

LEAD NITRATE INDUCED CHANGES IN THE BRAIN CONSTITUENTS OF THE FRESHWATER FISH CLARIAS BATRACHUS (L),
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
S. R. Katti, and A. G. Sathyanesan.
Neurotoxicology NRTXDN, Vol. 7, No. 3, p 47-52, Fall 1986. 2 tab, 42 ref.

Descriptors: *Lead nitrate, *Water pollution effects, *Fish physiology, *Population exposure, *Catfish, *Neurotransmitters, *Brains, *Enzymes, *Metabolism, Fish toxins, Histamine, Serotonin, Acetylcholinesterase, Cholesterol, Proteins, Ascorbic acid, Heavy metals, Lipids.

Exposure of C. batrachus to 5 ppm lead nitrate for 150 days resulted in a significant elevation of brain histamine and serotonin content, but Gamma aminobutyric acid level showed a decrease. Lead significantly reduced the brain monoamine oxidase and acetylcholinesterase activity. In addition, lead significantly lowered the brain lipid, cholesterol, protein, and ascorbic acid contents. These findings suggest that lead significantly impairs the brain neurotransmitter function. (Author's abstract)
W87-05564

2-DEOXYGLUCOSE UPTAKE IN THE DEVELOPING RAT BRAIN UPON PRE- AND POSTNATAL EXPOSURE TO TRICHLOROETHYLENE,
Miami Univ., Oxford, OH. Dept. of Zoology.
E. A. Noland-Gerbec, R. J. Pfohl, D. H. Taylor, and R. J. Bull.
Neurotoxicology NRTXDN, Vol. 7, No. 3, p 157-164, Fall 1986. 2 fig, 1 tab, 28 ref. EPA Grant CR-809618.

Descriptors: *Water pollution effects, *Population exposure, *Bioaccumulation, *Trichloroethylene, *Brains, *Rats, Gestation, Lactation, Animal pathology, 2-deoxyglucose, Animal metabolism, Drinking water, Sugars, Toxicity, Accumulation, Chlorinated hydrocarbons, Organic solvents.

The effects of trichloroethylene (TCE) on 2-deoxyglucose uptake by brain tissue were examined in pups from rat dams exposed to TCE in their drinking water. The pups were exposed throughout gestation and lactation. Deoxyglucose uptake in the cerebellum, hippocampus, and whole brain of the pups during the first 21 days of life was measured using a modification of the 2-deoxy-D-glucose (2-DG) technique. TCE at a nominal concentration of 321 mg/l significantly depressed 2-DG uptake in the whole brains and cerebella of 7- to 21-day old pups. 2-DG uptake was also lower in the hippocampus of exposed pups at 7, 11, and 16 days, but returned to control levels by 21 days. No overt toxicity, such as lower body or brain weight, was observed at this exposure level. This decrease in 2-DG uptake reflects a decrease in glucose uptake and/or metabolism in the brains of animals exposed to TCE. (Author's abstract)
W87-05565

EFFECTS OF HERBICIDE APPLICATION ON MORTALITY AND DISPERSIVE BEHAVIOR OF THE WATER HYACINTH WEEVILS, NEOCHETINA EICHHORNIAE AND NEOCHETINA BRUCHI (COLEOPTERA: CURCULIONIDAE),
Florida Univ., Gainesville. Dept. of Entomology and Nematology.
K. H. Haag.
Environmental Entomology EVETBX, Vol. 15, No. 6, p 1192-1198, December 1986. 2 fig, 2 tab, 15 ref. ARS-USDA, Cooperative agreement 58-7B30-3-570.

Descriptors: *Herbicides, *Water hyacinth weevils, *Water pollution effects, *Population exposure, *Aquatic insects, Animal behavior, Biocontrol, Mortality, Survival, Toxicity.

Toxicities of commonly used water hyacinth herbicides and additives to water hyacinth weevils, Neochetina eichhorniae Warner and N. bruchi Hustache, were tested. Weevils were either sprayed while on water hyacinth plants or dipped directly into the compounds tested. No significant mortality resulted from exposure to 2,4-D, diquat, glyphosate, or additives including a surfactant and a polymer. Exposure to an inverting oil and its primary component d'limonene resulted in significant mortality of both species at concentrations tested. Effects of herbicide exposure on flight muscle development seemed to be related to time of year at which exposure occurred. Effects of herbicide application on dispersive behavior were determined by placing marked weevils on artificial weed mats in the field. Mats were subsequently sprayed with a standard concentration of 2,4-D. Weevils consistently migrated from sprayed, dying plants to healthy, unsprayed plants. Implications for biocontrol strategies for water hyacinth are discussed. (Author's abstract)
W87-05583

VIRULENCE CHARACTERISTICS OF AEROMONAS SPP. IN RELATION TO SOURCE AND BIOTYPE,
Tasmania Univ., Hobart (Australia). Dept. of Pathology.
For primary bibliographic entry see Field 5A.
W87-05588

SALT TOLERANCE OF TWO DIFFERENTLY DROUGHT-TOLERANT WHEAT GENOTYPES DURING GERMINATION AND EARLY SEEDLING GROWTH,
Texas Tech Univ., Lubbock. Dept. of Biological Sciences.
For primary bibliographic entry see Field 3C.
W87-05593

INFLUENCE OF SALT STRESS ON BIOCHEMICAL PROCESSES IN CHICKPEA, CICER ARIETINUM L.,
Shivaji Univ., Kolhapur (India). Dept. of Botany.
For primary bibliographic entry see Field 3C.
W87-05594

LEGIONNAIRES' DISEASE CAUSED BY LEGIONELLA DUMOFFII IN DISTILLED WATER,
Laval Univ., Quebec. Dept. de Microbiologie.
For primary bibliographic entry see Field 5F.
W87-05598

CHANGING CONCEPTS AND IMPROVED METHODS FOR EVALUATING THE IMPORTANCE OF PCBS AS DREDGED SEDIMENT CONTAMINANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W87-05599

PHOSPHATE DETERGENTS - A CLOSER LOOK,
Soap and Detergent Association, New York.
For primary bibliographic entry see Field 5B.
W87-05603

RELATIONSHIP OF BONE MASS AND FRACTURE HISTORY TO FLUORIDE AND CALCIUM INTAKE: A STUDY OF THREE COMMUNITIES,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Div. of Nutritional Sciences.
For primary bibliographic entry see Field 5F.
W87-05615

ADAPTATION OF ESTUARINE ECOSYSTEMS TO THE BIODEGRADATION OF NITRILOTRIACETIC ACID: EFFECTS OF PREEXPOSURE,
North Carolina Univ. at Chapel Hill. Dept. of

Environmental Sciences and Engineering.
F. K. Pfaender, R. J. Shimp, and R. J. Larson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 587-593, 1985. 4 fig, 1 tab, 25 ref.

Descriptors: *Water pollution effects, *Estuaries, *Biodegradation, *Adaption, *Nitrilotriacetic acid, *Population exposure, *Isotope studies, *Marine bacteria, *Metabolism, Newport River, Jamaica Bay, Fraser River, Microorganisms, Organic compounds.

The biodegradation of nitrilotriacetic acid (NTA) was examined in three estuarine ecosystems, one of which had been exposed previously to the chemical. Biodegradation was measured as the conversion of radiolabeled NTA to 14CO2, 14C-labeled cells and the amount of label remaining in solution. The relatively unpolluted Newport River estuary system in North Carolina metabolized NTA slowly, with no apparent increase in rate over time. Jamaica Bay in New York showed an adaptation response, with approximately 50 d required for the onset of relatively rapid rates of biodegradation. The Fraser River estuary in Canada, exposed to NTA for more than 10 years, showed rapid degradation with no lag period at a concentration of 10 microgram(ug)/L. At 100 and 2,000 ug/L, short lag periods (2 to 4 d) were observed before rapid degradation rates were achieved. Measurements of NTA-degraders indicated that the Fraser River estuary contained 650/ml versus fewer than 10 in the Newport River and Jamaica Bay communities. The results demonstrate that NTA can be degraded by estuarine microorganisms. Estuarine bacteria will adapt to the presence of NTA in the environment and after adaptation, can respond to increased levels of the compound after relatively short lag periods. (Author's abstract)
W87-05617

USE OF QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIPS TO PREDICT THE ACUTE AND CHRONIC TOXICITIES OF ORGANIC CHEMICALS TO FISH,
MacLaren Plansearch, Inc., Toronto (Ontario).
L. S. McCarty, P. V. Hodson, G. R. Craig, and K. L. E. Kaiser.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 595-606, 1985. 5 fig, 3 tab, 28 ref.

Descriptors: *Water pollution effects, *Bioaccumulation, *Toxicity, *Prediction, *Organic compounds, *Fish physiology, *Water pollution effects, Hydrophobicity, Partition coefficient, Fish, Narcosis, Population exposure, Accumulation, Bioassay, QSAR.

Quantitative structure-activity relationships (QSARs) predict bioconcentration and acute toxicity to fish of chemicals causing narcosis on the basis of hydrophobicity, as measured by the octanol/water partition coefficient (K sub OW). Since the development of water quality objectives to protect fish is limited by the availability of suitable chronic toxicity data, we applied the QSAR concept to published and unpublished data to determine (a) whether chronic toxicity could be related to K sub OW and (b) whether application factors are constant, i.e., whether QSARs for acute and chronic toxicity are parallel. Our conclusions are as follows: (1) A QSAR, based on hydrophobicity (log K sub OW), appears to exist for the chronic toxicity of organic chemicals inducing acute toxicity by narcosis. Although not definitive, this QSAR was not parallel to that for acute toxicity and does not appear to support the concept of constant application factors. (2) Log K sub OW has a major effect on the rate of net bioconcentration of certain organic chemicals; therefore, the relationship of toxicity to log K sub OW may not be linear if exposure times are fixed, as very different amounts of toxicants will be taken up over a fixed time period. (3) As a result of the effect of log K sub OW on bioconcentration rates, many toxicity tests of relatively short, fixed duration may underestimate toxicity of some hydrophobic organic compounds, especially those exhibiting high log K sub OW values. Hence, water quality objectives developed directly from this data, without appropriate compensation, may not be restrictive enough. (4) To increase the accuracy, comparability and applicability of aquatic bioassay test results, especially for compounds of widely differing hydrophobicity, standard tests should be redesigned. For example, it may be more accurate if the exposure or dosage for the test organism is expressed as a summation of the periodically calculated product of body toxicant level and time up to predetermined summation values. (Author's abstract)
W87-05618

ACCUMULATION OF ZINC BY RAINBOW TROUT AS INFLUENCED BY PH, WATER HARDNESS AND FISH SIZE,
Guelph Univ. (Ontario). Dept. of Zoology.
R. W. Bradley, and J. B. Sprague.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 685-694, 1985. 2 fig, 4 tab, 51 ref.

Descriptors: *Bioaccumulation, *Trout, *Alkaline water, *Zinc, *Water pollution effects, *Path of pollutants, *Toxicity, *Fish physiology, *Metabolism, Fish, Heavy metals, Accumulation, Tissue analysis, Hydrogen ion concentration, Population exposure.

The intrinsic toxicity of zinc within fish may be defined as the amount of zinc present in the gills (the site of acute toxicity) at death. This intrinsic toxicity was similar in rainbow trout (Salmo gairdneri Richardson) that were exposed to zinc in acid or neutral water (pH 5.5 or 7.0) and in hard or soft water (total hardness 390 or 30 mg CaCO3/L). Since much more zinc was needed in the water to cause death at low pH and at high hardness, these conditions must alter the uptake and/or excretion dynamics of zinc in gill tissue to produce a slower rate of zinc accumulation. Additional evidence supporting this conclusion is presented. A 17-fold increase in fish size, from 1.7 to 29.0 g, reduced tolerance of zinc by a factor of 3.2, whereas a 14-fold increase in fish size, from 1.3 to 18.2 g, reduced the median lethal time by a factor of 2.7. This reduced tolerance and resistance in larger fish appeared to result from increased intrinsic toxicity of zinc. All sizes of fish showed similar rates of zinc accumulation in the gills, of about 40 microgram/g/h. (Author's abstract)
W87-05625

CHRONIC TOXICITY OF TEBUTHIURON TO AN ALGA (SELENASTRUM CAPRICORNUTUM), A CLADOCERAN (DAPHNIA MAGNA), AND THE FATHEAD MINNOW (PIMEPHALES PROMELAS),
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
R. D. Meyerhoff, D. W. Grothe, S. Sauter, and G. K. Dorulla.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 695-701, 1985. 2 fig, 4 tab, 21 ref.

Descriptors: *Toxicity, *Algae, *Cladocera, *Minnows, *Water pollution effects, *Tebuthiuron, Herbicides, Ponds.

Selective use of herbicides can control brush without physically disturbing topsoil, and individual plants can be treated for more local control. Herbicides in the form of foliar-applied sprays or soil-applied pellets can also be broadcast for widespread control of brush. Chronic toxicity studies were conducted with an alga (Selenastrum capricornutum), a cladoceran (Daphnia magna) and the fathead minnow (Pimephales promelas) to determine their relative sensitivities to tebuthiuron, a soil-applied herbicide. The alga was the most sensitive of the three species. The no observed effect concentrations for the studies with the fathead minnow (9.3 mg/L) and the cladoceran (21.8 mg/L) were higher than the algistatic concentration (1.5 mg/L) for Selenastrum. These concentrations are 8 to 121 times higher than the highest transient concentration of tebuthiuron reported for a catchment pond. (Alexander-PTT)
W87-05626

ENLARGED LIVERS AND HEPATIC MICROSOMAL MIXED-FUNCTION OXIDASE COMPONENTS IN TUMOR-BEARING BROWN BULLHEADS FROM A CHEMICALLY CONTAMINATED RIVER,
Columbia National Fisheries Research Lab., MO.
D. L. Fabacher, and P. C. Baumann.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 5, p 703-710, 1985. 3 tab, 28 ref.

Descriptors: *Water pollution effects, *Enzymes, *Bullheads, *Polluted rivers, *Tumors, Comparison studies, Fish physiology, *Bioindicators, Stress, Population exposure, Fish, Rivers, Pollutants.

Hepatic mixed-function oxidase (MFO) components in tumor-bearing brown bullheads (Ictalurus nebulosus) from a chemically contaminated river and in bullheads from two relatively uncontaminated sites were compared to determine if the components in the river bullheads were induced. Induction of MFO components could be indicative of chemical contamination of the river water and of contaminant stress in the fish. In general, biochemical hepatic microsomal MFO component levels in bullheads from the river were the same as, or lower than those in bullheads from uncontaminated sites. However, the liver weight as a percentage of body weight was significantly greater in bullheads from the river than in those from the uncontaminated sites. Thus, a comparison of bullheads from the river and uncontaminated sites appeared to show that relative liver weight was indicative of chemical contamination of the river water and of contaminant stress in its fish. However, biochemical hepatic microsomal components measured in this study were apparently not adequate as indicators of chemical contamination of the river water or of contaminant stress in bullheads from the river. (Author's abstract)
W87-05627

NEW FATHEAD MINNOW (PIMEPHALES PROMELAS) SUBCHRONIC TOXICITY TEST,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W87-05628

PLASMA LEUCINE AMINONAPHTHYLAMIDASE AS AN INDICATOR OF ACUTE SUBLETHAL TOXICANT STRESS IN RAINBOW TROUT,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W87-05637

EFFECT OF ORGANIC CHEMICALS ON GROWTH AND REPRODUCTION IN THE MARINE RED ALGA CHAMPIA PARVULA,
Environmental Research Lab., Narragansett, RI.
G. B. Thursby, R. L. Steele, and M. E. Kane.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 797-805, 1985. 10 fig, 3 tab, 18 ref. EPA Cooperative agreement CR810774-01-0.

Descriptors: *Water pollution effects, *Algal growth, *Marine algae, *Bioindicators, *Reproduction, *Organic compounds, *Aquatic toxicology, *Toxicity tests, Population exposure, Toxicity, Algae, Aquatic environment.

A previously developed static-removal toxicity test was used to test the effect of 10 organic chemicals on the growth and reproduction of the marine red alga Champia parvula (C. Agardh) Harvey. The test measured vegetative growth, formation of tetrasporangia (site of meiosis-asexual spore production) and production of cystocarps (evidence of sexual reproduction). The procedure was used to test the effects of one ketone (isophorone), two volatile hydrocarbons (benzene and naphthalene), three phenols (phenol, 2,4,5-trichlorophenol and pentachlorophenol) and four chlorinated hydrocarbons (2,4-dichlorophenoxyacetic acid, endosulfan, pentachloroethane and toxaphene). Chronic values were determined for vegetative growth and forma-

tion of reproductive structures based on statistically significant decreases from control levels. Absence of reproductive structures was also used to determine chronic values. No endpoint was consistently more sensitive than any other, and the ranking of the compounds from most to least toxic was similar regardless of the endpoint used. The results of these tests indicate that the Champia test is often as sensitive or more so than the most sensitive aquatic animal test and is almost always more sensitive than microalgae tests, demonstrating the importance of conducting chronic tests with the previously overlooked macroalgae. The test is easily conducted, sensitive and reproducible. (Author's abstract)
W87-05638

SHORT-TERM FISH AND AMPHIBIAN EMBRYO-LARVAL TESTS FOR DETERMINING THE EFFECTS OF TOXICANT STRESS ON EARLY LIFE STAGES AND ESTIMATING CHRONIC VALUES FOR SINGLE COMPOUNDS AND COMPLEX EFFLUENTS,
Thomas Hunt Morgan School of Biological Sciences, Lexington, KY.
For primary bibliographic entry see Field 5A.
W87-05639

STATIC ACUTE TOXICITY OF DIBROMONITRILOPROPIONAMIDE AND SELECTED DEGRADATION PRODUCTS TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS RAFINESQUE),
Dow Chemical U.S.A., Midland, MI. Mammalian and Environmental Toxicology.
M. A. Mayes, F. A. Blanchard, D. L. Hopkins, and I. T. Takahashi.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 823-830, 1985. 3 fig, 5 tab, 12 ref.

Descriptors: *Water pollution effects, *Toxicity, *Model studies, *Dibromonitrilopropionamide, *Biodegradation, *Metabolism, *Minnows, Pesticides, Organic compounds, Natural waters, Degradation.

Dibromonitrilopropionamide (DBNPA) is the active ingredient in Dow Antimicrobials 7287(R) and 8536(R). An important environmental feature of DBNPA is that it degrades very rapidly in water to a series of compounds including monobromonitrilopropionamide (MBNPA) and dibromoacetonitrile (DBAN). The objective of this study was to determine the toxicity of DBNPA, including the separate influences of the compound itself and of its degradation products, to the fathead minnow Pimephales promelas Rafinesque. The lability of DBNPA and the degradation products confounded the interpretation of the results. To aid in explaining the observed toxicity data, a model was used that treated DBNPA and its degradation products as a complex mixture, with the components having an assumed additive effect on the test species. Only DBNPA, MBNPA and DBAN were included in the evaluations because they were the primary components contributing to the toxicity of DBNPA, with 96-h LC50 values of 1.8, 3.4 and 0.55 mg/L, respectively. Analyses of the degradation and toxicity data confirmed the major role played by DBAN in the toxicity of initially applied DBNPA. They also suggested that in systems with nucleophilic activity, such as found in natural waters, there is a tendency to form more of the mono- and debrominated degradation products and fewer of the dibrominated degradation products, thus reducing the toxicity of initially introduced DBNPA. (Author's abstract)
W87-05640

MULTIDISCIPLINARY APPROACH TO THE ASSESSMENT OF OCEAN SEWAGE SLUDGE DISPOSAL,
EA Engineering, Science, and Technology, Inc., Sparks, MD.
For primary bibliographic entry see Field 5E.
W87-05641

BIOLOGICAL HALF-LIVES OF CHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN RAINBOW TROUT (SALMO GAIRDNERI),
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Fisheries Research Branch.
For primary bibliographic entry see Field 5B.
W87-05644

ARTHROPODS ASSOCIATED WITH PESTICIDE LEACH LINES IN SELECTED ORCHARDS IN CENTRAL NEW YORK,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
For primary bibliographic entry see Field 5E.
W87-05645

EFFECT OF SIMULATED ACID RAIN ON GROWTH AND YIELD OF VALENCIA ORANGE, FLORADADE TOMATO AND SLASH PINE IN FLORIDA,
Environmental Science and Engineering, Inc., Gainesville, FL.
R. Hart, R. H. Biggs, and P. G. Webb.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 79-85, January 1986. 7 tab, 21 ref.

Descriptors: *Acid rain, *Acid rain effects, *Water pollution effects, *Crop yield, *Simulated rainfall, *Acid deposition, Pine trees, Oranges, Tomatoes, Rainfall, Precipitation, Fruit crops, Plant growth, Florida.

Direct effects of simulated acidic deposition on vegetation were studied in the laboratory under controlled conditions for three commercially important resources: slash pine, Floradade tomato and Valencia orange. Treatment was similar to convective rain in Florida in ion composition, total volume, frequency and rate of application, intensity and sulfate/nitrate ratio. The surface of the growth medium was covered with plastic during application of the solution. Water and nutrients optimum for growth were provided directly to the growth medium. No visible injury resulted from application of the simulated rain. No effects of pH treatments on vegetative growth of slash pine, orange or tomato were observed. However, fruit yield of tomato and orange differed significantly between plants subjected to different pH treatments. The yield of tomato was lower and that of orange was higher at the lower pH treatments. The yield of tomato was lower and that of orange was higher at the lower pH treatments. Calcium and magnesium levels were highest in the foliage of tomato plants receiving the pH 5.5 treatment. No differences in element levels of orange foliage were observed. (Author's abstract)
W87-05647

TOXICITY OF FLURIDONE TO AQUATIC INVERTEBRATES AND FISH,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
J. L. Hamelink, D. R. Buckler, F. L. Mayer, D. U. Palawski, and H. O. Sanders.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 87-94, January 1986. 1 fig, 9 tab, 16 ref.

Descriptors: *Toxicity, *Fluridone, *Aquatic invertebrates, *Fish physiology, *Water pollution effects, *Herbicides, *Bioaccumulation, Population exposure, Life cycles, Aquatic toxicology, Growth, Survival, Weed control, Fish, Larvae, Minnows.

The acute and chronic toxicities of the herbicide fluridone to aquatic invertebrates and fish were evaluated. The acute median lethal concentrations (LC50s) of fluridone were 4.3 + or - 3.7 mg/L for invertebrates (n=15) and 10.4 + or - 3.9 mg/L for fish (n=28). In chronic studies, no effects were detected when daphnids (Daphnia magna) were continuously exposed to fluridone concentrations of 0.2 mg/L or less for 32 d, amphipods (Gammarus pseudolimnaeus) to 0.6 mg/L or less for 60 d or midge larvae (Chironomus plumosus) to 0.6 mg/L or less for 30 d. Fathead minnows (Pimephales promelas) were not affected by continuous exposure to fluridone concentrations of 0.48 mg/L or less over their life cycle. The growth and survival of channel catfish (Ictalurus punctatus) were not adversely affected by continuous exposure to fluridone concentrations of 0.5 mg/L or less for 60 d after hatching. The channel catfish accumulated fluridone concentrations two to nine times greater than that in the water. The recommended application rate of 1 lb/acre of fluridone to a pond with an average depth of 3 ft provides a theoretical concentration of 0.1 mg/L. Thus, an initial fluridone concentration of 0.1 mg/L or less is recommended to control weeds in ponds. Consequently, fluridone is not expected to have adverse effects on the species tested or on similar nontarget aquatic organisms. (Author's abstract)
W87-05648

ACUTE TOXICITY OF CADMIUM, COPPER, MERCURY AND ZINC TO TROPOCYCLOPS PRASINUS MEXICANUS (CYCLOPOIDA, COPEPODA) FROM THREE QUEBEC LAKES,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
M. Lalande, and B. Pinel-Alloul.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 95-102, January 1986. 2 fig, 3 tab, 40 ref.

Descriptors: *Toxicity, *Cadmium, *Copper, *Mercury, *Zinc, *Heavy metals, *Copepods, *Water pollution effects, *Lakes, Cultures, Comparison studies, Zooplankton, Alkalinity, Population exposure, Quebec.

This study deals with cultures of Tropocyclops prasinus mexicanus, a Cyclopoid copepod from three Quebec lakes (one polluted and two unpolluted), in a comparative toxicity test involving four heavy metals. Experiments were performed according to a static toxicity protocol. The 48-h EC50 of each individual metal and of the combination of metals were determined for each culture. The overall toxicity trend is mixture > Hg > Cu > or = Cd > or = Zn. Cultures from unpolluted and low-hardness lakes showed lower EC50 mean values than did the strain originating from the polluted lake with high water hardness. (Author's abstract)
W87-05649

CONDITIONAL STABILITY CONSTANTS AND BINDING CAPACITIES FOR COPPER (II) BY DISSOLVED ORGANIC CARBON ISOLATED FROM SURFACE WATERS OF THE SOUTHEASTERN UNITED STATES,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. P. Giesy, J. J. Alberts, and D. W. Evans.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 2, p 139-154, February 1986. 7 fig, 6 tab, 54 ref. Savannah River Ecology Lab Contract ET-76-C-09-0819; DOI Grant A-121-Mich.

Descriptors: *Path of pollutants, *Water chemistry, *Dissolved organic carbon, *Mathematical studies, *Model studies, *Copper, *Chemical processes, Water pollution effects, Chelation, Humic matter, Geochemistry, Prediction, Binding capacity.

Dissolved organic carbon (DOC), isolated from each of nine surface waters in the southeastern United States, was fractionated into two nominal molecular size fractions, i.e., 52 Angstroms(A) < fraction I < 4,500 A < fraction II < 52 A. The binding capacities and overall conditional stability constants (K') for copper were determined by selective ion electrode. There was no significant difference between binding capacities of fractions I and II. Sensitivity analyses showed that the overall mean binding capacity was adequate for use in simulation models. We estimated overall conditional stability constants by seven mathematical techniques, including both discrete and continuous models. The thermodynamic, geochemical simulation model GEOCHEM was used to determine the sensitivity of predictions to variation in both binding capacity and overall conditional stability constants estimated by each technique. Predictions

were compared with titrations of isolated humate fractions and whole waters. The two-component Scatchard function, a discrete model, and the Gaussian-Scatchard function, a continuous model, gave the most accurate predictions in these simulations. Stability constants (K') were calculated for measured values of free and bound metal and ligand across a metal-organic ligand titration curve. These values were dependent on the copper/total ligand ratio and varied on a continuum of binding strength by as much as a factor of 100 for a given fraction and location. The means of maximum conditional stability constants calculated across locations were 520000 and 59000 for fractions I and II, respectively. The median, maximum conditional stability constant for fraction II was significantly weaker than that for fraction I. The number of sites with each K' were log10-normally distributed, with proportionately more of the weaker binding sites. (Author's abstract)
W87-05651

COMPARISONS OF SINGLE-SPECIES, MICROCOSM AND EXPERIMENTAL POND RESPONSES TO ATRAZINE EXPOSURE,
Corvallis Environmental Research Lab., OR.
D. P. Larsen, F. deNoyelles, F. Stay, and T. Shiroyama.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 2, p 179-190, February 1986. 6 fig, 4 tab, 40 ref. EPA Cooperative agreement CR808804.

Descriptors: *Population exposure, *Atrazine, *Water pollution effects, *Toxicity tests, *Bioassay, *Algae, Comparison studies, Biomass, Microcosms, Ponds, Bioaccumulation, Isotope studies, Pesticides, Organic compounds, Oxygen, Respiration.

Results from single-species toxicity tests form the basis for guidance about concentrations of chemicals that are likely to be environmentally hazardous. Microcosm bioassays have been proposed as better tools for this purpose under some circumstances. Rarely have comparisons been made among the responses in the various test systems and those seen in natural communities. We compared the responses among single-species algal assays, a synthetic microcosm (the Taub microcosm) and experimental ponds exposed to similar concentrations of atrazine by comparing concentrations of atrazine that reduced algal activity or biomass to 50% of control values (EC50). Eight algal species were examined; mean species EC50 values for 14C uptake ranged from 37 to 308 microgram(ug)/L. For the Taub microcosm, EC50 values were 103 to 159 ug/L for 14C uptake, 126 to 165 ug/L for dissolved oxygen production and 106 to 164 ug/L for dissolved oxygen consumption. Values were dependent on the time intervals selected for calculations. In the ponds, EC50 values for 14C uptake were 100 ug/L and for chlorophyll a, 82 ug/L. The basic similarity among EC50 values across test systems suggests that results from a combination of single-species assays, or the Taub microcosm, provided a reasonable estimate of the concentration of atrazine that produced similar direct effects on more natural communities. (Author's abstract)
W87-05655

ADAPTATION OF SELENASTRUM CAPRICORNUTUM (CHLOROPHYCEAE) TO COPPER,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. S. Kuwabara, and H. V. Leland.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 2, p 197-203, February 1986. 1 fig, 2 tab, 26 ref.

Descriptors: *Adaptation, *Copper, *Water pollution effects, *Bioassay, *Algal growth, Heavy metals, Toxicity, Algae, Population exposure.

Selenastrum capricornutum Printz, growing in a chemically defined medium, was used as a model for studying adaption of algae to a toxic metal (copper) ion. Cells exhibited lag-phase adaptation to 0.8 micromolar total Cu after 20 generations of Cu exposure. Selenastrum adapted to the same concentration when Cu was gradually introduced over an 8-h period using a specially designed apparatus that provided a transient increase in exposure concentration. Cu adaptation was not attributable to media conditioning algal exudates. Duration of lag phase was a more sensitive index of copper toxicity to Selenastrum that was growth rate or stationary-phase cell density under the experimental conditions used. Chemical speciation of the Cu dosing solution influenced the duration of lag phase even when media formulations were identical after dosing. Selenastrum initially exposed to Cu in a CuCl2 injection solution exhibited a lag phase of 3.9 d, but this was reduced to 1.5 d when a CuEDTA solution was used to achieve the same total Cu and EDTA concentrations. Physical and chemical processes that accelerated the rate of increase in cupric ion concentration generally increased the duration of lag phase. (Author's abstract)
W87-05656

TOXICITY OF FIVE ALKYL-ARYL PHOSPHATE ESTER CHEMICALS TO FOUR SPECIES OF FRESHWATER FISH,
Columbia National Fisheries Research Lab., MO.
L. Cleveland, F. L. Mayer, D. R. Buckler, and D. U. Palawski.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 273-282, March 1986. 7 tab, 27 ref.

Descriptors: *Toxicity, *Phosphate esters, *Fish physiology, *Water pollution effects, *Bioaccumulation, *Trout, *Minnows, *Catfish, *Bluegills, Life cycles, Organic compounds, Pollutants, Growth, Survival, Fish, Population exposure.

The toxicities of five phosphate ester compounds - Fyrquel GT, Kronitex 200, Phosflex 31P, Pydraul 50E and Santicizer 148 - were evaluated in acute toxicity tests with rainbow trout (Salmo gairdneri), fathead minnows (Pimephales promelas), channel catfish (Ictalurus punctatus) and bluegills (Lepomis macrochirus) and in 90-d partial life-cycle tests with fathead minnows. Nominal exposure concentrations were 0, 0.06, 0.12, 0.25, 0.5 and 1.0 mg/L in the partial life-cycle tests with Fyrquel GT, Kronitex 200, Phosflex 31P and Pydraul 50E, and 0, 0.05, 0.09, 0.19, 0.38 and 0.75 mg/L in the test with Santicizer 148. The 96-h LC50 values for rainbow trout, fathead minnows, channel catfish and bluegills exposed to the five phosphate esters ranged from less than 0.3 to greater than 72 mg/L. The LC50 values may be directly related to the percentage of triphenyl phosphate contained in each of the compounds. The phosphate esters generally showed similar chronic toxicities to fathead minnows, and adverse toxic effects occurred at nominal exposure concentrations of 0.38 to 1.0 mg/L. Comparison of available environmental concentration data for phosphate esters with the effect concentrations obtained for fish in the present study indicated that phosphate ester compounds may not now pose a threat to fish populations. (Author's abstract)
W87-05659

FIELD STUDY OF PHYSIOLOGICAL EFFECTS ON FISH IN LEAD-CONTAMINATED LAKES,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
C. Haux, A. Larsson, G. Lithner, and M.-L. Sjobeck.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 283-288, March 1986. 3 fig, 1 tab, 18 ref.

Descriptors: *Field tests, *Fish physiology, *Water pollution effects, *Polluted lakes, *Lead, Enzymes, Sweden, Whitefish, Teleosts, Heavy metals, Lakes, Fish, Tissue analysis, Toxicity.

In a field investigation, physiological parameters were studied in whitefish (Coregonus spp.) living in lead-contaminated lakes in northern Sweden. Fish from an uncontaminated lake were used as a reference. The activity of the enzyme delta-aminolevulinic acid dehydratase in blood was inhibited up to 88% in fish from lead-contaminated lakes, as compared with fish from the reference lake, indicating the presence of lead pollution. In addition, higher blood glucose levels and lower plasma sodium content were observed in fish from lead-contaminated lakes. These results suggest that lead affects fish in the environment in a way similar to that observed in laboratory experiments. (Author's abstract)
W87-05660

EFFECT OF PULSE EXPOSURE TO METHOXYCHLOR ON BRAIN SEROTONIN LEVELS IN AMERICAN FLAGFISH (JORDANELLA FLORIDAE, GOODE AND BEAN) AS MODIFIED BY TIME AFTER EXPOSURE, CONCENTRATION AND GENDER,
Waterloo Univ. (Ontario). Dept. of Biology.
D. A. Holdway, B. D. Sloley, R. G. H. Downer, and D. G. Dixon.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 289-294, March 1986. 3 tab, 19 ref. NRC (Canada) Contract OST83-00153; NSERC (Canada) Grant A6084.

Descriptors: *Methoxychlor, *Population exposure, *Water pollution effects, *Serotonin, *Flagfish, Insecticides, Tryptophan, Organic compounds, Pesticides, Fish.

Adult American flagfish (Jordanella floridae) were exposed for 2 h to 1.6, 1.9, 3.1 or 5.1 mg/L of the chlorinated hydrocarbon insecticide methoxychlor. Control and ethanol-carrier control treatments were also maintained. Fish were sampled at 2, 6, 24, 48 and 336 h after exposure, and the concentrations of tryptophan, serotonin and 5-hydroxyindole acetic acid in brain tissue were determined. Flagfish exposed to the three highest concentrations of methoxychlor had significantly lower concentrations of serotonin, relative to controls, 2, 6 and 24 h after exposure. Serotonin concentrations had returned to control levels by 48 h. The period of serotonin depression corresponded with observed convulsive activity in the exposed fish. Female flagfish had significantly higher brain levels of serotonin than did males. Although tryptophan and 5-hydroxyindole acetic acid levels were unaffected by methoxychlor exposure, the levels of both were significantly depressed by the concentration of ethanol carrier (270 mg/L) used. Serotonin levels were unaffected by ethanol. The brain weight of flagfish was found to be related to body weight by the equation brain weight (mg) = 2.53 + 5.72 body weight (g) ($n = 139$; r squared = 0.74; $p < 0.001$). (Author's abstract)
W87-05661

INVESTIGATION OF THE HEPATIC MIXED-FUNCTION OXIDASE SYSTEM IN HERRING GULL EMBRYOS IN RELATION TO ENVIRONMENTAL CONTAMINANTS,
Canadian Wildlife Service, Ottawa (Ontario). Wildlife Toxicology Div.
D. C. Boersma, J. A. Ellenton, and A. Yagminas.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 309-318, March 1986. 2 fig, 6 tab, 46 ref.

Descriptors: *Enzymes, *Herring fulls, *Embryos, *Water pollution effects, *Great Lakes, *Bioindicators, Mortality, Survival, Organic compounds, Pesticides, Lakes, Water fowl, Eggs.

Hepatic enzyme activity in 25-d embryos from eight colonies in the Great Lakes and one relatively uncontaminated colony in the Bay of Fundy were measured. This was done to further investigate the use of the mixed-function oxidase system of herring gull (Larus argentatus) embryos for bioeffects monitoring. The changes in ethoxyresorufin 0-dealkylation (ERoD) and the rate of aminopyrene-N-demethylation (APDM) across the Great Lakes were small. However, the rate of aniline hydroxylation (AnH) was significantly depressed in seven of eight colonies when compared with control colony. This suppression was greatest in embryos from the three colonies in Lake Ontario, where mirex levels were highest. Organochlorines were measured in egg homogenates from each

colony. There was a significant negative correlation of the rate of APDM with both polychlorinated biphenyl and hexachlorobenzene levels and also of the rate of AnH with mirex levels. In conjunction with the above, an egg injection experiment using three doses each of hexachlorobenzene and mirex and was conducted to elucidate these compounds' effects on the enzymes measured. The effects on body weight, liver weight and enzyme activity were small compared with the mortality incurred in the eggs injected with hexachlorobenzene. The embryonic LD50 for hexachlorobenzene was calculated as 4.3 ppm. Mortality in the controls injected with 1,4-dioxane was 20%, and that of eggs injected with mirex was similar to that of controls. (Author's abstract)
W87-05663

COMPARISON OF THE EFFECTS OF SURFACTANTS ON FRESHWATER PHYTOPLANKTON COMMUNITIES IN EXPERIMENTAL ENCLOSURES AND ON ALGAL POPULATION GROWTH IN THE LABORATORY,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
M. A. Lewis.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 3, p 319-332, March 1986. 4 fig, 4 tab, 55 ref.

Descriptors: *Surfactants, *Water pollution effects, *Phytoplankton, *Algal growth, *Field tests, *Toxicity, Population exposure, Organic compounds, Dissolved oxygen, Taxonomy, Growth, Algae.

Field validation of laboratory toxicity data for phytoplankton is uncommon but it is important, since results from standard single-species laboratory tests are often used in assessing the environmental safety of a chemical. This study reports the short-term in situ effects of three surfactants on the community structure of enclosed natural assemblages of phytoplankton. Standard diversity and similarity indices, mean species number density and changes in dissolved oxygen concentration were determined for phytoplankton enclosed in 26-liter bottles after 10 d of exposure in Acton Lake, Ohio. The first observed effect concentrations based on commonly calculated indices of community structure occurred at 108, 8.4 and 2.9 mg/l, respectively, for the anionic, nonionic and cationic surfactants. In contrast, lower effect levels (< 1.0 mg/l) based on changes in density of some major taxa were observed. Since standard algal toxicity tests assume a degree of environmental relevancy, the community effect levels were compared with effect concentrations developed in standard laboratory algal toxicity tests monitoring changes in population growth of single test species. The community effect levels could be predicted in some cases; however, the degree of similarity between the laboratory and field results was very dependent on the surfactant, the laboratory test species and the effect parameter. (Author's abstract)
W87-05664

BENTHOS IN A SEDIMENT-LADEN DELTA STREAM SYSTEM,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W87-05831

ENVIRONMENTAL ASPECTS OF SEDIMENTATION,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 2J.
W87-05834

ROLE OF SEDIMENT IN ACCELERATED EUTROPHICATION,
Oklahoma State Univ., Stillwater.
A. N. Sharpley.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 459-469, 3 fig, 1 tab, 43 ref. ARS Cooperative Agreement No. 58-7B30-2-416.

Descriptors: *Eutrophication, *Sediments, *Path of pollutants, *Water pollution effects, *Sediments, Phosphorus, Nitrogen, Erosion, Sediment transport, Runoff, Bioassay.

Due to atmospheric exchange of nitrogen and carbon with surface water, phosphorus often limits and is of prime importance in the control of accelerated eutrophication. Sediment is an integral part of this process. The bioavailability and reactivity of P, in terms of P sorption-desorption of eroded sediment, is greater than source soil due to the selective removal of fine material during runoff. Relationships between soil loss and the enrichment of sediment bound P (particulate P) forms are presented, which allow the prediction of runoff losses and capacity of sediment to alter solution P concentration in streams and lakes. A literature survey showed that 0-95% of particulate P in runoff and deposited sediments can be potentially bioavailable (utilized by algae), as measured by several chemical extractants and algal bioassays. There is need for development and standardization of a simple chemical extraction method to estimate bioavailable P, so that more information on a less site-specific basis can be obtained. Further research should be directed toward an improvement of models partitioning soluble and particulate P in runoff and water bodies. (See also W87-05791) (Author's abstract)
W87-05839

WATER QUALITY IMPACTS FROM SEDIMENT IN THE SOUTHEAST,
Tennessee Valley Authority, Knoxville, TN. Environmental Quality Staff.
A. M. Duda.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 488-497, 3 fig, 1 tab, 24 ref.

Descriptors: *Water pollution effects, *Suspended sediment, *Sediment load, *North Carolina, *Tennessee, Sediment yield, Economic aspecs, Agriculture, Dredging, Aquatic environment.

The significance of water quality, aquatic biological, and economic damage from excessive sediment loading was examined in different physiographic areas of North Carolina and Tennessee. Investigations show sediment to be the primary water quality problem facing the two States, with widespread use impairment of waters in agricultural, mining, and urban areas. Suspended sediment yields range from 5-10 metric tons(mt)/sq km/yr in forested watersheds to 370 and 850 mt/sq km/yr in some agricultural and coal mined areas, respectively. Economic and public safety impacts occurred as well, ranging from increased flooding, extensive dredging requirements, decreased agricultural productivity, and filling of reservoirs to actual loss of human life associated with bridge collapses on unstable, channelized waterways. Impediments to achieving Clean Water Act goals include: (1) the accelerated drainage and conversion of wetlands to cropland; (2) failure to enact, enforce, or fund programs for soil erosion and nonpoint pollution control; 'loopholes' in Federal and State regulatory requirements; and increased storm runoff from mining, urban, and agricultural areas. Major policy changes in existing Federal and State programs and establishment of new programs (emphasizing the integration of land and water management, nonpoint pollutioon control, and rehabilitation of problem watersheds) are needed if sediment-related nonpoint pollution problems are to be remedied and billions of dollars in adverse economic impacts are to be reduced. (See also W87-05791) (Author's abstract)
W87-05842

DRAGONFLIES AS INDICATORS OF THE CONDITIONS OF RUNNING WATERS IN THE LOWER PARTS OF NORTHWESTERN GERMANY (LIBELLEN ALS INDIKATOREN DES ZU STANDES VON FLIESSGEWAESSERN DES NORDWESTDEUTSCHEN TIEFLANDES),
Technische Univ. Braunschweig (Germany, F.R.). Zoologisches Inst.
For primary bibliographic entry see Field 2H.
W87-05896

CLASTOGENIC EFFECTS OF FIVE CARCINOGENIC-MUTAGENIC CHEMICALS ON THE CELLS OF THE COMMON CARP, CYPRINUS CARPIO L,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
K. Al-Sabti.
Comparative Biochemistry and Physiology (C), Vol. 85, No. 1, p 5-9, 1986. 2 tab, 2 fig, 30 ref.

Descriptors: *Mutagens, *Fish physiology, *Carcinogens, *Water pollution effects, *Aromatic compounds, *Carp, Erythrocytes, Fish, Organic compounds.

The cytogenic effects of various i.p. treatments with five carcinogenic mutagenic chemicals and three doses for each (aflatoxin B1, Arocior 1254, benzidine, benzo(a)pyrene, and 20-methylcholanthrene) were investigated. The mutagens were injected as corn oil solutions. Injections with distilled water or corn oil provided two control groups. Cytogenetic damage was detected via two test systems, chromosomal aberrations (CA) in kidney cells and micronucleated erythroyctes (M). At 48 hours after treatment with the chemicals the frequencies of CA and M were elevated in a clear dose-response manner compared to the control groups. (Author's abstract)
W87-05899

EFFECT OF SUB-LETHAL DOSES OF DIELDRIN ON THE VENTILATORY AND CARDIAC ACTIVITY IN TWO SPECIES OF SHRIMPS,
University of the West Indies, Kingston (Jamaica). Dept. of Zoology.
V. Lawrence, R. E. Young, and A. Mansingh.
Comparative Biochemistry and Physiology (C), Vol. 85, No. 1, p 177-181, 1986. 6 fig, 36 ref.

Descriptors: *Dieldrin, *Pesticides, *Ventilation, *Water pollution effects, *Shrimp, Toxicity, Commercial fishing, Bioaccumulation, Jamaica, Aquaculture, Popluation exposure.

The recently intensified use of pesticides in Jamaica (AGRO 21 Program) makes it essential to determine the levels at which pesticide use may become counterproductive by endangering marine resources. The effect of dieldrin on the heart and ventilatory activity in the shrimps Macrobrachium faustinum and Macrobrachium amazonicum was studied over 4 and 7 day exposure periods, respectively. In M. faustinum, ventilatory rate increased by 43% and heart rate by 14.4%. In M. amazonicum, the veltilatory and heart rates decreased by 21 and 6% respectively. In the same species the ventilatory reversal frequency, an index of respiratory stress, was 6.7 times higher than the control values. All the changes, with the exception of M. amazonicum heart rate, were significant at the 0.01 level of probability. (See also W87-05901) (Airone-PTT)
W87-05900

EFFECT OF SUB-LETHAL DOSES OF DIELDRIN ON RESTING AND ACTIVE METABOLISM IN TWO SPECIES OF SHRIMPS,
University of the West Indies, Kingston (Jamaica). Dept. of Zoology.
V. Lawrence, R. E. Young, and A. Mansingh.
Comparative Biochemistry and Physiology (C), Vol. 85, No. 1, p 183-186.

Descriptors: *Metabolism, *Dieldrin, *Pesticides, *Water pollution effects, *Shrimp, Commercial fishing, Oxygen uptake, Jamaica, Aquaculture, Population exposure.

Increased use of pesticides in Jamaica may endanger aquatic species important for aquaculture. The effects of dieldrin on the active (V sub a O2) and resting (V sub r O2) oxygen consumption rates of the shrimps Macrobrachium faustinum (de Saus-

sure) and Macrobrachium amazonicum (Heller) were studied during exposure for 4 days at 0.01 ppb and 7 days at 0.0002 ppb respectively. V sub r O2 of M. faustinum increased significantly ($P<0.01$) by 48% but the V sub a O2 decreased by 13%. Both V sub r 02 and V sub a 02 decreased in M. amazonicum, 43% and 70% respectively. Thus in both species the aerobic metabolic scope for activity decreased. The increased resting metabolic rate of the indigenous M. faustinum is ascribed to energy consuming responses which allow compensation for the effects of the stressor. The stressor may be said to have resting metabolic rate of the pond-cultured M. amazonicum is ascribed to greater susceptibility, more extensive metabolic breakdown and failure of compensatory responses. M. amazonicum may be said to have been forced by the stressor into a metabolic zone of collapse. (See also W87-05900) (Author's abstract)
W87-05901

INHIBITION STUDY OF THE NITRIFICATION BY ORGANIC COMPOUNDS (ETUDE DE L'INHIBITION DE LA NITRIFICATION PAR LES COMPOSES ORGANIQUES),
Rennes-1 Univ. (France).
For primary bibliographic entry see Field 5F.
W87-05902

ENVIRONMENTAL MODIFICATION OF THE PHOTOSYNTHETIC RESPONSE OF LAKE PLANKTON TO SURFACTANTS AND SIGNIFICANCE TO A LABORATORY-FIELD COMPARISON,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
M. A. Lewis, and B. G. Hamm.
Water Research WATRAG, Vol. 20, No. 12, p 1575-1582, December 1986. 3 fig, 2 tab, 40 ref.

Descriptors: *Surfactants, *Photosynthesis, *Plankton, *Field tests, *Lakes, *Water pollution effects, Acton Lake, Detergents, Cultures, Toxicity, Diatoms, Species composition, Temperature.

The toxic effects of nine surfactants on the short-term photosynthetic activity of lake plankton and factors affecting the response were investigated in multiple monthly studies conducted during May-October of 1982 and 1983 at Acton Lake (Ohio). The impact on photosynthesis differed with the mean 3 h EC sub 50 values ranging from 0.6 to 28.7 mg/l. The photosynthetic response to the same surfactant varied as much as 80 x, attributed in part to monthly changes in water temperature (range 17-28 C) and to seasonal differences in phytoplankton composition. Overall the test chemicals were less toxic during periods of lower water temperature, diatom dominance and low algal density. The in situ photosynthesis results were compared to those from standard algal laboratory toxicity tests to assess the environmental relevance of a laboratory data base. These 96 h tests were conducted with the same surfactants but monitored growth effects on three cultured algae. Based on this comparison the laboratory effect concentrations were typically either similar to or lower than those in the field. Key considerations in this laboratory field comparison were the environmental modification of the photosynthetic response, the surfactant type, and the differential sensitivities of the cultured laboratory algae. (Author's abstract)
W87-05917

BACTERIAL GLUCOSE MINERALIZATION IN ACID-STRESSED LAKE SEDIMENTS,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-05918

5D. Waste Treatment Processes

RENOVATING WASTEWATER WITH GROUNDWATER RECHARGE IN THE PHOENIX AREA,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 331-346, 1 fig, 13 ref.

Descriptors: *Wastewater renovation, *Groundwater recharge, *Phoenix, *Arizona, *Water reuse, Irrigation, Agriculture, Wastewater, Secondary wastewater treatment, Salt River.

The city of Phoenix, with a population of 800,000 in 1980, is the largest city in the Salt River Valley, located in south central Arizona. The dominant irrigation district in the Salt River Valley is the Salt River Project, which covers an area of about 250,000 acres. Water use in the area of the Salt River Project is about 1.2 million acre-ft/yr. Two-thirds of this amount comes from the Salt and Verde rivers, on which six storage dams have been constructed. The remaining one-third is pumped from the groundwater with about 250 deep wells. This groundwater gets very little natural recharge (other than irrigation return flow), and is essentially a nonrenewable water resource. Projections of water supply and demand for the Phoenix area outside the Salt River Project indicate a deficit of about 120,000 acre-ft/yr by the year 2035. The present sewage flow is about 160,000 acre-ft/yr, of which about half will be used for cooling a nuclear power plant starting in the mid to late 1980s. The rest of the effluent or almost 80,000 acre-ft/yr, will be available for other uses. A logical use of the sewage effluent would be irrigation of agricultural land. In the Phoenix studies, secondary effluent was used because that was what the treatment plants provided. The results of the Phoenix studies show that the renovated water from the SAT projects meets the public health, agronomic, and aesthetic requirements for unrestricted irrigation, including vegetable crops that are consumed raw. The water also meets the standards for lakes with primary contact recreation. Potable use of the renovated water will require additional treatment, for example, activated carbon adsorption, reverse osmosis, and disinfection. Such treatment, however, will be more effective and economical for renovated water from a soil-aquifer treatment system than for effluent from a conventional sewage treatment plant. (See also W87-05219) (Lantz-PTT)
W87-05241

ANAEROBIC TREATMENT OF STARCH-CONTAINING WASTEWATER USING A PLATE-COLUMN REACTOR,
Fermentation Research Inst., Yatabe (Japan).
K. Tanaka, E. Mikami, and T. Suzuki.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 3, p 259-263, June 1986. 3 fig, 2 tab, 6 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Anaerobic digestion, *Starch, *Advanced wastewater treatment, Biomass, Organic carbon, Activated sludge, Sludge digestion, Temperature effects, Performance evaluation.

An anaerobic plate-column reactor developed to retain a high concentration of biomass was studied in regard to its start-up profile and the effects of total organic carbon (TOC) loading rate, hydraulic retention time (HRT) and steady state temperature using starch-containing synthetic wastewater. Each operation was started up at an initial biomass concentration of about 0.5 milligrams nitrogen per milliliter, a 30-hour HRT and a total organic carbon loading rate of 0.8 grams per liter per day. Dissolved organic carbon removal efficiency exceeded 90% after 29 days and reached a steady state at 98% removal after 116 days. Circulation of effluent at a ratio of one gave a lower removal efficiency and a lower biomass concentration than the same reactor without circulation. The effect of TOC-loading rate was studied at an HRT of 30 hours at 20 C and removal efficiencies were found to be 91% at 1.6 grams per liter per day and 77% at 3.2 grams per liter per day. The effect of HRT was studied at a TOC-loading rate of 0.8 grams per liter per day at 20 C and removal efficiencies were found to be 91% at an HRT of 12 hours and 72% at an HRT of six hours. (Author's abstract)
W87-05274

PRETREATMENT OF PECTIC WASTEWATER FROM ORANGE CANNING BY SOFT-ROT ERWINIA CAROTOVORA,
Government Industrial Research Inst., Shikoku, Takamatsu (Japan).
H. Tanabe, Y. Kobayashi, and I. Akamatsu.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 3, p 265-268, June 1986. 4 fig, 19 ref.

Descriptors: *Wastewater treatment, *Biodegradation, *Advanced wastewater treatment, *Pretreatment of water, *Citrus fruits, *Canneries, *Pathogenic bacteria, Activated sludge process, Enzymes, Chemical oxygen demand, Uronic acids, Decomposition, Dissolved oxygen, Nutrients.

Erwinia carotvora FERM P-7576, a soft-rot pathogen screened for biochemical pulping, was used to dispose of pectic wastewater discharged from orange canning factories as a pretreatment for an activated sludge process. Twelve-hour bacterial pretreatment made it possible to reduce chemical oxygen demand and total uronic acids by 10% and 84%, respectively, with supplementation of some nutrients and keeping dissolved oxygen constant. Enzymatic pretreatment using crude enzyme from this strain degraded almost all the pectic substances in this waste to the level of tetramers and pentamers within 24 hours. Enzymatic pretreatment was found to provide more rapid decomposition of the chemically very resistant pectic substances than other chemical, physical or biological treatment methods. (Author's abstract)
W87-05275

SEWAGE SLUDGE COMPOSTING MAINTAINS MOMENTUM,
For primary bibliographic entry see Field 5E.
W87-05280

NITROGEN AVAILABILITY IN DEWATERED SLUDGE,
Washington County Unified Sewerage Agency, Hillsboro, OR.
For primary bibliographic entry see Field 5E.
W87-05281

COMPOSTING PROCESS DESIGN CRITERIA: PART IV-CASE STUDY,
R. T. Haug, and L. D. Tortorici.
Biocycle BCYCDK, Vol. 27, No. 10, p 34-39, November-December 1986. 4 fig, 2 tab, 3 ref.

Descriptors: *Performance evaluation, *Land disposal, *Wastewater treatment, *Composting, *Design criteria, Oxnard, Sludge drying, Sludge cake, Odor control, Pathogens, Process control, Sludge bed, Case studies, California.

A series of papers to present a unified approach to process design and operation of composting systems was developed. This part presents a case study in applying the recommended design approach and design criteria to an actual system. The city of Oxnard, Ca. adopted a plan to construct a new solids dewatering and composting facility. Estimated composting costs were higher than current costs for landfill sludge disposal, but the proposed system will not be subject to escalating costs due to landfill regulation or closure of alternative landfill sites. Design concept development included recognition of site specific considerations and constraints, including odor control, pathogen destruction, minimal usage of and flexibility in the selection of amendments and production of high quality compost suitable for bagged product sale. Continuous, belt-filter presses using polymer conditioning were selected for dewatering. An in-vessel reactor process was selected for the first stage of composting. A windrow system for the curing phase offered a number of advantages and incorporated an all-weather design and natural ventilation. Oxnard's semi-arid climate permitted air drying of wet cake during peakload months as well as air drying in windrows. A circular, agitated bed reactor was selected for the first stage because

of its amendment flexibility. A computer program to calculate mass and energy balances was developed and aeration requirements were determined. The procedures discussed in this series provide an integrated approach to process design of the first and seconds stages of composting which are scientifically sound, practical and usable. (Michael-PTT)
W87-05282

WASTE MANAGEMENT IN KOREA,
Environment Administration, Seoul (Republic of Korea).
D. H. Rhee, Y. H . Ko, and L. F. Diaz.
Biocycle BCYCDK, Vol. 27, No. 10, p 44-48, November-December 1986.

Descriptors: *Waste management, *Wastewater treatment, *Korea, *Recycling, Municipal wastewater, Liquid sludge, Septic sludge, Land disposal Solid wastes, Landfills, Plastics, Coal ash, Composting, Waste recovery, Fuel, Compost.

Korea's rapid economic development has resulted in increased pollution from inadequately controlled discharge of municipal and industrial wastes. Four municipal wastewater treatment plants serve 12% of the nation's urban population. Of the 10 million kiloliters of waste generated annually, only 4 million kiloliters are collected and properly treated. Additional treatment capacity has been constructed in both urban and rural areas. The per capita rate of solid waste generation is about 2 kilograms per day, but this rate fluctuates because of the high ash content of municipal solid wastes. Resource recovery and utilization is used for solid waste management by separating plastic, paper, metal, glass and rubber from other components of the waste stream. The Korea Resources Recovery and Reutilization Corporation was established to deal specifically with the recovery of resources from solid wastes. Incineration is used for plastics not amenable to recycling and the heat generated is recovered and applied to household and commercial uses. Coal ash is recovered from combustion of anthracite briquettes to make bricks for the construction industry. In rural areas, solid and liquid wastes may be composted or digested using biogass reactors to generate methane. A full-scale resource recovery and reuse facility is being constructed in Seoul to recover waste by-products and produce compost and densified refuse-derived fuel. In Korea, a shortage of natural resources and decreasing availability and rising costs of landfill sites make resources recovery from solid wastes increasingly attractive. (Michael-PTT)
W87-05284

STRATEGIES FOR AERATED PILE SYSTEMS,
Washington Suburban Sanitary Commission, Hyattsville, MD.
C. M. Murray, and J. L. Thompson.
Biocycle BCYCDK, Vol. 27, No. 6, p 22-28, July 1986. 3 fig, 7 tab, 8 ref.

Descriptors: *Wastewater treatment, *Scrubbers, *Design standards, *Odor control, *Composting, *Wastewater treatment facilities, *Aeration, *Sludge bed, Montgomery County composting facility, Performance evaluation, Moisture content, Oxygen depletion, Maryland, Temperature control, Exhaust air treatment.

Faced with pressures created by local citizens, operators, at the Montgomery County Composting Facility, have continuously modified the facility, operating procedures, and the static aerated pile process itself in an effort to manage odor control problems. The findings presented in this report may be useful to operators of other large scale facilities. Initial efforts to control odor centered on maintaining optimum temperature and oxygen parameters, and an exhaust air treatment system. The results of the Odor Control Studies are presented, and focus on three main objectives: (1) to optimize operation of the exhaust air odor scrubbing system, (2) to establish odor emission rates for the various portions of the operation, and (3) to develop odor control methods to eliminate off-site odor impacts. The Odor Control Study and the resultant facility improvements represent a comprehensive effort to understand the production, transport and control of odors at the facility. (Jessick-PTT)
W87-05297

SOIL DEODORIZATION SYSTEMS,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
M. Terasawa, M. Hirai, and H. Kubota.
Biocycle BCYCDK, Vol. 27, No. 6, p 28-32, July 1986. 2 fig, 4 tab, 4 ref.

Descriptors: *Odor control, *Biological treatment, *Soil filters, *Wastewater treatment, Bodenfilters, Wastewater facilities, Japan, Maintenance, Construction costs, Performance evaluation.

Recently, biological deoderization systems have begun to attract increasing attention because it is possible to operate them economically and efficiently. Although bodenfilters have been in operation in Japan for some time, a systematic compilation of data from an operational point of view is lacking. The investigation reported herein grew out of the need to fill in the data gap. It will be essential to work on the progress of biological deodorization and to develop better biofilters. For example, we have used peat instead of soil as a packing material in the biofilter and have obtained very promising results. (Author's abstract)
W87-05298

SOIL FILTERS AT TREATMENT PLANT,
M. A. Selby.
Biocycle BCYCDK, Vol. 27, No. 6, p 33, July 1986.

Descriptors: *Soil filters, *Wastewater facilities, *Wastewater treatment, *Odor control, Moisture content, Hydrogen sulfide, *Florida, Tamarac.

Mechanisms associated with the Soil Filter Matrix are odor removal, physical adsorption, chemical oxidation, moisture content, and biological assimilation. These factors were examined at a system in Tamarac, Florida where 5 to 30 ppm hydrogen sulfide were being emitted from a primary equalization tank a wastewater treatment plant. Prior to the installation of this soil filter unit, the municipality was under regulatory pressure to implement some type of odor control quickly. After completing the plant's startup phase, odor complaints have essentially dropped to zero. (Jessick-PTT)
W87-05299

MAKING SLUDGE REUSE MORE SUCCESSFUL,
Black and Veatch, Kansas City, MO.
G. F. Shimp.
Biocycle BCYCDK, Vol. 27, No. 6, p 34-35, July 1986.

Descriptors: *Water reuse, *Wastewater treatment, *Waste disposal, *Sludge disposal, *Wastewater management, *Sludge utilization, Wilmington, Sludge, North Carolina, Denver, Colorado, Seattle, Washington, Bristol, Nashville, Tennessee, Fort Collins, Sludge thickening, Sludge drying, Sludge digestion.

Generators of sludge are becoming aware of the needs of the user. Rather than trying to mold the users' attitudes and habits to satisfy their own needs, generators are beginning to develop sludge management practices around user needs. Generators are now more willing to make more than one form of sludge product available, making reuse more attractive. Contract operators' spirit of enterprise has created many innovative solutions to problems frequently encountered in sludge handling and disposal. By making sludge products available in more than one form and by enhancing sludge management practices, the potential sludge product market will increase and a greater portion of the total sludge production can be used more beneficially. (Jessick-PTT)
W87-05300

HOW TO USE PRIVATIZATION FOR A COMPOSTING PROJECT,
For primary bibliographic entry see Field 6C.
W87-05302

SPRAY IRRIGATION CHALLENGED IN VERMONT,
D. Schauer.
Biocycle BCYCDK, Vol. 27, No. 6, p 52-54, July 1986.

Descriptors: *Wastewater treatment, *Water law, *Regulations, Spray irrigation, Water quality standards, Vermont.

Sunrise Mountain Village, a housing development near Killington, VT announced plans to increase their spray irrigation capacity prior to phasing in 550 condominiums over the next eight to ten years. Although sewage levels have not yet been high enough to require its use, one spray irrigation field received a Certificate of Compliance from the state Water Resources Board to begin operating. Recognizing that current regulations no longer addressed the technological advances and population growth, Vermont's Governor Kunin made plans to revise them. The resulting bill (S. 42) resulted in new water quality standards. (Jessick-PTT)
W87-05303

APPROPRIATE TECHNOLOGY FOR THE TREATMENT OF WASTEWATERS FOR SMALL RURAL COMMUNITIES.
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
Euro Reports and Studies 90, Report of a WHO Meeting, Lyon, June 7-11, 1982. WHO Regional Office for Europe, Copenhagen, Denmark. 1985. 62 p, 9 fig, 5 append.

Descriptors: *Wastewater Treatment, *Wastewater management, *Quality control, *Rural areas, *Wastewater facilities, Waste disposal, Activated sludge, Trickling filters, Biodiscs, Activated sludge process, Septic tanks, Waste disposal, Aeration.

This report was written as part of the strategy for the International Drinking Water Supply and Sanitation Decade. In all countries of Europe sanitation systems are designed mainly for urban communities. In many countries these systems have simply been transferred to small rural areas. However this involves a number of difficulties; in particular, the cost of sanitation per person is much higher as economies of scale are not possible, and the treatment techniques are not suited to the educational level of the operators, so that plants do not operate at maximum efficieny. The possibilities, limitations, and conditions, including the quality of control requirements in the treatment of effluents, and the operation and supervision of plants, are considered for wastewater treatment in small rural areas. Conventional methods of wastewater treatment are described as well as on-site methods such as septic tanks, where satisfactory operation depends on the size and design of the infiltration units. Also mentioned are techniques for localities without piped water supplies. It is recommended that reliability of quality be increased by using systems that are less sensitive to increases in water pressure, and that have extra capacity and storage or settlement tanks. Operation and supervison requires improvement at a number of levels, including the design of simple systems and operating facilities and assistance to operators. (Ram-PTT)
W87-05322

ANALYSIS OF RESEARCH NEEDS CONCERNING THE TREATMENT, UTILIZATION, AND DISPOSAL OF WASTEWATER TREATMENT PLANT SLUDGES.
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5E.
W87-05325

COMPOSTING,
For primary bibliographic entry see Field 5E.
W87-05328

INCINERATION,
Vrije Univ., Brussels (Belgium). Dept of Chemical Engineering Techniques and Industrial Chemistry.
For primary bibliographic entry see Field 5E.
W87-05329

ANIMAL WASTES,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5E.
W87-05330

RESEARCH NEEDS ASSOCIATED WITH TOXIC SUBSTANCES IN WASTEWATER TREATMENT SYSTEMS.
Water Pollution Control Federation, Washington, DC.
Water Pollution Control Federation, Washington, District of Columbia, (1982). 300 p.

Descriptors: *Research priorities, *Monitoring, *Toxins, *Pollutant identification, *Fate of pollutants, Sludge, Wastewater treatment, Toxicity, Biological wastewater treatment, Chemical treatment, Sorption, Adsorption, Separation techniques, Wastewater analysis.

An extensive assessment of research needs associated with wastewater treatment systems was made, with an overall emphasis placed on monitoring strategies for specific substances which may or may not be toxic, detection and measurement of such specific substances in wastewater suspensions and residues, fate of these substances in sewarage systems as well as in physical, chemical and biological unit operations, and processes used in wastewater and sludge treatment. A comprehensive national monitoring strategy that minimizes redundancy and maximizes interaction between state and federal regulatory agencies is needed. The establishmnet of a national monitoring advisory committee comprised of public and private participants is recommended to periodically review national monitoring programs. The research needs identified for the unit operations and processes used in the treatment of wastewaters and sludges were grouped into several common research needs in the areas of gas transfer (stripping), sorption, phase separation, biological reactions, and chemical reactions. (Geiger-PTT)
W87-05335

EPA HANDBOOK FOR IMPROVING POTW PERFORMANCE.
Water Pollution Control Federation, Washington, DC.
Water Pollution Control Federation, Alexandria, Virginia, 1985. 258 p.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Performance evaluation, *Handbooks, Standards, Evaluation, Cost analysis, Design criteria, Wastewater management, Administration, Maintenance, Process control.

Methods to economically improve the performance of existing publicly owned treatment works (POTWs) through application of the Composite Correction Program (CCP) approach are presented. The CCP brings together the positive features of many individual programs to correct all the specific performance-limiting problems identified at a subject plant. To identify facilities where performance could be improved without further construction, a Comprehensive Performance Evaluation (CPE) phase was developed. The CPE is performed to determine if a CCP could result in significant improvement in plant performance and/or capacity. Descriptions are given of how to conduct CPEs an CCPs. Methods used during the CCP for improving design performance-limiting factors, maintenance performance-limiting factors, administrative performance-limiting factors, and operational performance-limiting factors are outlined along with CPE and CCP examples and their results. (Geiger-PTT)
W87-05336

USE OF CUMULATIVE SUM ANALYSIS TO ASSESS POLICY IMPACTS ON THE RIVER EBBW, WALES,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5G.
W87-05345

NOVEL ACTINOMYCETE ISOLATED FROM BULKING INDUSTRIAL SLUDGE,
Alabama Univ. in Birmingham. Dept. of Biology.
J. M. White, D. P. Labeda, M. P. Lechevalier, J. R. Owens, and D. D. Jones.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 6, p 1324-1330, December 1986. 4 fig, 1 tab, 36 ref.

Descriptors: *Actinomyces, *Isolation, *Bulking sludge, *Wastewater treatment, *Activated sludge, *Industrial wastewater, Bacteria, Microorganisms, Biochemistry, Morphology, Homology, DNA, Taxonomy.

Successful operation of the activated sludge process depends on separation of the microbial biomass from the treated water in a clarifier. Sludge bulking, which is the inability of the biomass to settle properly, represents a major problem associated with this treatment method. Control of bulking has been largely empirical, and studies have often lacked a characterization of the organism (or organisms) involved. Conditions suspected to cause bulking include low dissolved-oxygen concentration, high and low organic loading, industrial inputs, nutrient deficiencies, and flow configuration. A few studies have attempted to correlate a single condition with the presence of filamentous growth. Organisms are usually characterized on the basis of microscopic observations. A novel actinomycete was the predominant filamentous microorganism in bulking activated sludge in a bench-scale reactor treating coke plant wastewater. The bacterium was isolated and identified as an actinomycete that is biochemically and morphologically similar to Amycolatopsis orientalis; however, a lack of DNA homology excludes true relatedness. At present, the isolate (NRRL B 16216) cannot be assigned to the recognized taxa of actinomycetes. (Alexander-PTT)
W87-05398

GRAVITY SANITARY SEWER DESIGN AND CONSTRUCTION.
American Society of Civil Engineers, New York.
ASCE Manuals and Reports on Engineering Practice No. 60. WPCF Manual of Practice No. FD-5. American Society of Civil Engineers, New York, New York and the Water Pollution Control Federation, Washington, DC, 1982. 275 p.

Descriptors: *Sanitary sewers, *Design criteria, *Sewer hydraulics, *Wastewater collection, *Construction methods, Gravity flow, Sewer systems, Wastewater disposal, Wastewater treatment, Sewers, Pipes, Corrosion, control, Sulfides, Sanitary engineering.

A manual providing both theoretical and practical guidelines for the design and construction of gravity sanitary sewers is based on the experience of engineers in the field of sanitary sewer structural and hydraulic design. The initial chapter introduces the organization and administrative phases of the sanitary sewer project. Subsequent chapters are presented in a sequence detailing the parameters necessary to establish the design criteria, complete the design and award a construction contract. Topics covered include: surveys and investigations; determining quantity of wastewater; sulfide generation, corrosion and corrosion protection in sanitary sewers; sewer hydraulics; design of sanitary sewer systems; appurtenances and special structures; materials for sewer construction; structural requirements; construction contract documents; and construction methods. Charts, illustrations and example problem solutions are used liberally throughout to reinforce the text. (Geiger-PTT)
W87-05400

EVALUATION OF THE TEST METHOD 'ACTIVATED SLUDGE, RESPIRATION INHIBITION TEST' PROPOSED BY THE OECD,
Gifu Coll. of Medical Technology, Seki (Japan). Dept. of Hygiene.
Y. Yoshioka, H. Nagase, Y. Ose, and T. Sato.
Ecotoxicology and Environmental Safety EESADV, Vol. 12, No. 3, p 206-212, December 1986. 5 fig, 1 tab, 7 ref.

Descriptors: *Analytical methods, *Activated sludge, *Respiration, *Inhibition, *Detection limits, *Toxicity testing, *OECD, Performance evaluation, Toxicity, Chemicals, Growth inhibition, Water pollution effects.

The test method of chemical toxicity using activated sludge has been studied by many investigators. The factors which affect the respiration of activated sludge and the relation between the respiration inhibition test and other biological tests have been reported. That the specific glucose uptake was a convenient method of assessing inhibition of the activated sludge process by toxic chemicals has been reported. The test method of 'activated sludge, respiration inhibition test' proposed by the OECD was critically carried out and compared with other test methods. Investigation of test conditions showed that the moderate deviation from the test conditions defined by the OECD Test Guidelines did not have much effect on the result, and some modifications were proposed to improve the method. This method had a poor detection limit compared with the LC50 test with Oryzias latipes and EC50 of the growth inhibition test with Tetrahymena pyriformis. The susceptivity of the method was particularly poor for the chemicals which were highly toxic in the other two tests. (Alexander-PTT)
W87-05411

DETERMINATION OF THE PERMISSIBLE AMOUNT OF LIQUID ANIMAL WASTE APPLIED TO SOIL FILTERS,
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
For primary bibliographic entry see Field 5G.
W87-05436

PURIFICATION OF FACAL LOADED CIRCULATION WATER IN A SEAL POOL OF A ZOO (REINIGUNG EINES FAEKALBELASTETEN KREISLAUFWASSERS IM ROBBENBECKEN EINES ZOOS),
P. K. J. Ensenauer.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 5, p 169-176, October 1986. 5 fig, 6 tab, 5 ref.

Descriptors: *Wastewater treatment, *Animal wastes, *Wastewater, *Flocculation, *Filtration, *Feces, Water treatment, Water reuse, Pollutants, Seals, Aquatic animals, Zoos, Feces, Germany, Physicochemical properties, Physicochemical treatment, Ozonation, Activated carbon, Organic wastes, Oxidation process.

The treatment of the water from a pool of seals in a German zoo was investigated. Seals consume their food in the water and deposit their excreta there but are sensitive to contaminated water and cannot tolerate the chemicals generally used for used for human water treatment. The cost of fresh water daily is prohibitive so, after the quantity of organic contaminants was determined, a multistage process using aerobic biological oxidation as the first stage was introduced. The carrier of the biomass was activated carbon which was located in a backwash filter and thus functioned as an initial filtration stage. Using downstream ozonation with a flocculation stage specifically designed for the pilot plant, followed by multistage filtration, it was possible to maintain the TOC and physicochemical values of the circulation water. The phosphate level in the treated water was so low that eutrophication was greatly reduced. It was demonstrated that it was possible to achieve excellent results without using strong chemicals. (Wood-PTT)
W87-05459

SORPTION OF CHROMIUM(VI) ON HYDROUS IRON OXIDES,
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2K.
W87-05462

OZONE DISINFECTION OF PRIMARY EFFLUENT USING A STIRRED TANK REACTOR,
Department of the Environment, Ottawa (Ontario). Technical Services Branch.
D. L. Caverson, G. R. Finch, and D. W. Smith.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 5, p 510-516, October 1986. 1 fig, 5 tab, 23 ref. NSERC (Canada) Grant A1010.

Descriptors: *Wastewater treatment. *Primary wastewater treatment, *Chemical treatment, *Ozone, *Disinfection, *Stirred reactors, *Models studies, *Mathematical modles, Coliforms, Wastewater, Bacteria, Mathematical equations, Mathematical studies, Effluents, Biological oxygen demand, Least squares method.

A pilot-scaled stirred tank reactor was used to evaluate the efficiency of ozone for disinfecting primary effluent. Total and fecal coliform numbers before and after disinfection were evaluated concomitant with several common wastewater characteristics. A disinfection model was built using the method of linear least squares. The model enables the designer to choose the transferred ozone dose to achieve a given number of indicator bacteria in the effluent when BOD sub 5 is known. The model was found to be useful for the primary effluent studied but should not be used in other applications without pilot plant investigations. Examination of similar models reported in the literature suggests that weak wastewaters (COD < 25 mg/l) may be described by a regression model using COD and tranferred ozone as variables but extrapolation to moderate and strong wastewaters, as was done in this study, introduced gross errors. Further research into the fundamental kinetics of ozone disinfection of wastewater is necessary before a reliable model is available. (Author's abstract)
W87-05465

NEW CONCEPT OF UPFLOW CLARIFICATION IN ACTIVATED SLUDGE SEPARATION,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
A. B. Sparling, and D. L. Woytowich.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 5, p 517-522, October 1986. 8 fig, 4 tab, 7 ref.

Descriptors: *Activated sludge, *Sludge, *Activated sludge processes, *Wastewater treatment, *Clarification, *Clarifiers, Upflow clarification, Solids, Solid wastes, Design criteria, CFLUC, Sludge separation, Dairy industry, Bioflocculation, Flocculation, Performance evaluation, Pollution load.

An experimental investigation was conducted to evaluate a new concept of upflow clarification. A novel sludge removal mechanism that used the entire floor area for the removal of solids was incorporated in an upflow clarifier. The operating characteristics and design features of the continuous flux upflow clarifier (CFLUC) are described in detail. The laboratory study was conducted to determine the effectiveness of the CFLUC in separating sludges with different settling characteristics. The different sludge types were produced by an activated sludge system treating a synthetic dairy waste at four different food to microorganism (F:M) ratios. At low organic loadings (0.10-0.24 grams COD/gram MLVSS/d), the CFLUC removed 70% of the pigment floc that remained during quiescent batch settling conditions. At high organic sludge loadings (0.41-0.83 grams COD/gram MLVSS/d), the CFLUC was capable of separating filamentous bulking sludges with poor settling characteristics. Based on the results of the experimental study the upflow clarifier effectively separated all sludge types over the range of organic loadings investigated. (Author's abstract)
W87-05466

ANAEROBIC TREATMENT OF HIGH-SULFATE WASTES,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
J. A. Oleszkiewicz, and B. L. Hilton.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 4, p 423-428, August 1986. 4 fig, 4 tab, 20 ref.

Descriptors: *Sulfates, *Anaerobic, *Wastewater treatment, *Wastes, *Waste disposal, *Sludge, *Anaerobic digestion, Waste load, Pollution load, Performance evaluation, Organic wastes, High-sulfate wastes, Sludge bed, Anaerobic digestion, Chemical oxygen demand, Sodium sulfate, Fatty acids.

Six parallel upflow anaerobic sludge bed reactors were operated at chemical oxygen demand (COD) loads from 3 to 10 kg COD/cu m/d. Four reactors (R1-R4) were fed sodium sulfate at loads 1-3 kg S-SO4/cu m/d. Reactors R1 and R2 were fed spent cheese whey with R1 being operated in an unstripped and R2 in a stripped mode. At COD loads below 5 kg/cu m/d, the removal in R1 was 60-80% COD and generally trailed R2 by a margin of 0-15%. At higher COD loads and at higher SO4/COD ratios, the performance of R1 deteriorated significantly. A similar situation was found in the pair R3 (unstripped) and R4 (stripped), which was fed a mixture of spent whey and sulfite cooking liquor. Reactors R5 and R6 were subjected to the same feed as R3 and R4, but no sulfate was added. A comparison of R4 with R6 indicated slightly lower COD removal in R4 with similar amounts of volatile fatty acids accumulating in both reactors in cases of overloading. (Author's abstract)
W87-05471

EFFLUENT TREATMENT EXPERIENCE AT A HIGH-GRADE URANIUM MINE,
Amok Ltd, Saskatoon (Saskatchewan).
T. P. Hynes, T. Meadley, and N. Thompson.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 4, p 429-437, August 1986. 1 fig, 14 tab, 3 ref.

Descriptors: *Radioactive wastes, *Effluents, *Wastewater treatment, *Industrial wastewater, *Wastewater management, *Wastewater, *Uranium, Saskatchewan, Cluff Lake, Uranium radioisotopes, Radium radioisotopes, Isotopes, Pollutants, Performance evaluation.

Amok Ltd. is the operator of uranium mining and milling facilities at Cluff Lake in northwestern Saskatchewan. All contaminated liquid effluents from these facilities were subjected to treatment by chemical and physical methods before release to the environment. In particular, a secondary treatment system (STS) was operated adjacent to the tailings management area to reduce the concentration of radium-226 to below the maximum levels allowable in the final effluent. The STS has operated for over 2 years at a nominal rate of 4000 cu m/day. During this time, the most stringent regulatory limit on radium-226 concentration (0.37 Bq/L = 10 times 10 to the minus 12th power grams/L total, based on a monthly arithmetic mean) has been exceeded on only two occasions. The process regularly removes 99% of the radium from the effluent stream. Data is presented on chemical addition rates, efficiencies of system components, and the significance of each stage of the treatment process. In addition, several modifications were made to the STS. Recently, a primary treatment system was added to the effluent treatment process. Preliminary indications are that this system has increased the overall efficiency of the system. (Author's abstract)
W87-05472

ENVIRONMENTAL EFFECTS ON GROSS PRODUCTION AND RESPIRATION IN A FACULTATIVE OXIDATION POND,
Auckland Univ. (New Zealand). Dept. of Botany.
D. E. Irving, and F. I. Dromgoole.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 1-8, 1986. 3 fig, 2 tab, 21 ref.

Descriptors: *Wastewater treatment, *Effluents, *Algae, *Productivity, *Oxidation ponds, *Photosynthesis, *Respiration, Nutrients, Temperature, Pigments, Light intensity.

Oxygen exchange by effluent samples taken at weekly intervals from a facultative oxidation pond was investigated over a 7 month period. Concentrations of ammonia, nitrate, nitrite, total and reactive phosphorus, alkalinity, total inorganic carbon, and free CO2 were measured over 12 months. Gross daily oxygen production within the community compensation depth ranged from 8 g O2/sq m in winter to 43 g O2/sq m in summer. The corresponding range for dark respiration was 5-17.5 g O2/sq m/d. On average, light saturated rates of net oxygen production and total net production extended to the upper 2 and 15% of the 1.3 m mean depth profile respectively. Community respiration to gross production ratios ranged from 1.38-7.14. Light saturated rates of net oxygen production and dark rates of oxygen consumption increased with seasonal rise in pond temperature as did net production per unit detectable pigment. However, the most important factor affecting the rate of oxygen production was the concentration of detectable pigment. In laboratory studies, oxygen exchange rates were optimal at pH 5-8, but rates declined rapidly as the pH was increased from 8.0-8.5. Pond pH varied between 6.7 and 7.8 throughout the year. Net CO2 uptake under saturating irradiance (at pH 4.5) was maximal at 30 micromolar CO2, and compensation was reached at about 5 micromolar CO2. The minimum concentration of free CO2 observed in the pond was 190 micromolar. (See also W87-05511) (Author's abstract)
W87-05510

ALGAL POPULATIONS AND CHARACTERISTICS OF OXYGEN EXCHANGE OF EFFLUENT SAMPLES FROM A FACULTATIVE OXIDATION POND,
Auckland Univ. (New Zealand). Dept. of Botany.
D. E. Irving, and F. I. Dromgoole.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 20, No. 1, p 9-16, 1986. 3 fig, 1 tab, 14 ref.

Descriptors: *Algal populations, *Oxygen exchange, *Photosynthesis, *Effluents, *Oxidation ponds, *Wastewater treatment, Microalgae, Algae, Light intensity, Monitoring, Pigments.

Algal populations in a facultative oxidation pond were monitored over a 12 month period. The relationships between cell counts of individual species and characteristics of oxygen exchange, determined from changes in dissolved oxygen concentration in response to varying light flux density, were investigated by correlation analysis. These measurements were made in the laboratory at a constant temperature (15 C). Microalgae (Chlorella spp.) usually made up at least 80% of the total cell numbers, whereas Euglena acus, E. gracilis, and Ankistrodesmus falcatus var. acicularis separately made up less than 10% of the total counts. However, when cell volumes were considered, E. acus usually made the greatest contribution, and this species accounted for 86% (= r squared) of the variation in total cell volume. The detectable pigment concentration in the water was closely related to the numbers of E. acus present (r=0.81, P < 0.001) but not to the numbers of microalgae (r=0.00). Cell counts of E. acus were highly correlated with the light saturated rate of net oxygen production (P sub n max) and to the rate under limiting light supply (theta) because of the high detectable pigment contribution from this species. It was calculated that E. acus contributed, on average, about 44% of the total rate of net oxygen production, whereas the proportion attributed to the microalgae was 8%. (See also W87-05510) (Author's abstract)
W87-05511

CHARACTERIZATION OF XYLAN-UTILIZING ANAEROBES FROM MESOPHILIC AND THERMOPHILIC METHANE SLUDGE AND THEIR XYLAN-DEGRADING ENZYMES,
Osaka Univ. (Japan). Faculty of Science.

T. Tanaka, Y. Shimomura, M. Himejima, M. Taniguchi, and S. Oi.
Agricultural and Biological Chemistry ABCHA, Vol. 50, No. 9, p 2185-2192, September 1986. 3 fig, 5 tab, 21 ref.

Descriptors: *Biological wastewater treatment, *Anaerobic bacteria, *Thermophilic bacteria, *Xylan, *Wastewater treatment, *Enzymes, Sludge, Fermentation, Mesophilic bacteria, Butyric acid fermentation, Bacterial physiology.

A mesophilic and three thermophilic clostridial species were newly isolated as potent xylan-utilizing bacteria from mesophilic and thermophilic methane sludge, respectively. The mesophilic strain (X-4) had a characteristic fermentation pattern of xylan, producing ethanol and acetic acid in addition to hydrogen and carbon dioxide. The thermophiles (XY-6, XY10, and XY-23) were strains of the typical butyric acid fermentation type. The utilization of xylan by strain X-4 was evident at late exponential or early stationary growth phase followed by an increase in production of xylanase in the culture fluid, whereas xylan was fermented by the thermophilic strains from the beginning of their cultivation. Cell-bound xylanase was detected in the three thermophilic strains. Enzyme secreted into the medium (supernatant xylanase) was detected in strains XY-6 and XY-10 but not in strain XY-23. The actions of xylanase preparations from X-4 and XY-6 were characterized, indicating that cell-bound beta-xylosidases were also involved in the degradation of xylan by both strains. (Author's abstract)
W87-05543

SCREENING FOR AND CHARACTERISTICS OF MICROBIAL FLOCCULANTS,
Fermentation Research Inst., Yatabe (Japan).
R. Kurane, K. Takeda, and T. Suzuki.
Agricultural and Biological Chemistry ABCHA, Vol. 50, No. 9, p 2301-2307, September 1986. 1 fig, 6 tab, 14 ref.

Descriptors: *Biological wastewater treatment, *Flocculation, *Activated sludge, *Bacteria, *Kaolin clay, *Wastewater treatment, Cations, Dredge spoil, Suspended sediments, Fly ash, Activated charcoal, Sedimentation.

Fourteen strains of the genera Rhodococcus, Nocardia, and Corynebacterium were found to produce substances that flocculate kaolin clay. R. erythropolis produces a kind of the microbial flocculant, which had interesting and unique flocculating characteristics. It could efficiently flocculate all suspended solids in aqueous solution tested. Among those effectively tested were microorganisms such as Escherichia coli and alcohol yeast, activated sludge, Microcystis aeruginosa, kaolin clay, muddy water, river dredging muddy water, river bottom sediment, ash from a steam power station, and ground activated charcoal powder. The flocculant from R. erythropolis had a wide flocculating activity against both organic and inorganic materials. Cations such as Ca(2+) also significantly increased the flocculating activity. (See also W87-05545) (Author's abstract)
W87-05544

CULTURE CONDITIONS FOR PRODUCTION OF MICROBIAL FLOCCULANT BY RHODOCOCCUS ERYTHROPOLIS,
Fermentation Research Inst., Yatabe (Japan).
R. Kurane, K. Toeda, K. Takeda, and T. Suzuki.
Agricultural and Biological Chemistry ABCHA, Vol. 50, No. 9, p 2309-2313, September 1986. 7 fig, 1 tab, 11 ref.

Descriptors: *Culturing techniques, *Biological wastewater treatment, *Flocculation, *Activated sludge, *Bacterial physiology, *Kaolin clay, *Wastewater treatment, Yeast extract, Amino acids, Sugars, Urea, Growth, Temperature, Culture media.

Addition of yeast extract and casamino acids stimulated the production of a flocculant by Rhodococcus erythropolis. The favorable substrates for flocculant formation were fructose (or glucose), urea, and yeast extract. Optimum culture temperature and optimum culture pH for the production of the flocculant were 30 C and pH 8.5-9.5, respectively. Excess aeration decreased the production of the flocculant. The production of the flocculant paralleled the growth curve. More than 90% of the flocculating activity was in the culture broth and less than 10% in the cells. (See also W87-05544) (Author's abstract)
W87-05545

WASTEWATER DISINFECTION AND INFECTIOUS DISEASE RISKS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 17, No. 1, p 1-20, 1986. 5 tab, 108 ref.

Descriptors: *Water pollution effects, *Viruses, *Bacteria, *Human diseases, *Disinfection, *Wastewater treatment, *Risks, Chlorination, Coliforms, Self-purification, Economic impact.

Infectious agents in wastewater (viruses, bacteria), evidence of disease transmission, quantitative risk estimation, and economic impacts of disease caused by wastewater-contaminated surface waters are reviewed. Methods for quantitative estimation of risk can be direct (viral densities in raw wastewater, viral removal by unit processes, inactivation of virus by chlorine, and decay of virus in receiving waters) or based on indicators (coliforms in wastewater treatment, in-stream decay of coliforms and indicators, and Enterococcus indicators). A procedure for formal risk assessment is outlined that involves each of three approaches, namely, use of pathogens directly, use of coliforms, and use of enterococcus organisms. Economic impacts associated with primary case risks were estimated at $ 60-550/case for disease associated with wastewater contaminated surface waters. (Rochester-PTT)
W87-05548

PHYSICAL CHARACTERISTICS OF ACTIVATED SLUDGE FLOCS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
D.-H. Li, and J. J. Ganczarczyk.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 17, No. 1, p 53-87, 1986. 1 fig, 8 tab, 127 ref.

Descriptors: *Literature reviews, *Biological wastewater treatment, *Activated sludge, *Flocculation, *Sewage bacteria, *Wastewater treatment, Water content, Calculations, Physical properties.

Thirteen physical characteristics of activated sludge are indicated based on an extensive literature review, and their corresponding values and various influencing factors are discussed. Floc size, number and length of filamentous microorganisms, and floc-settling velocity and density have been defined very well and can be measured directly. Irregularity is the major feature in regard to the shape of activated sludge flocs, even though many investigators have proposed numerous common shapes in the flocs. Because a floc can be observed microscopically in only one direction, it is difficult to determine its three-dimensional shape. Although there are many well-developed methods for calculation of floc water content, porosity, and floc strength, it is difficult, or even impossible, to measure directly these parameters for individual flocs. Floc strength is not a well-defined concept, and there is no widely acceptable criterion that can be used to describe it very clearly. However, floc strength has been related to the real behavior of the activated sludge process and used to predict and control its performance. Compared with other characteristics, floc pore radius and tortuosity, which concern the detailed structure of the flocs, do not appear to be that important for studies of the activated sludge process. (Rochester-PTT)
W87-05549

SLUDGE DISPOSAL THINKING SIMILAR IN U.K., U.S.,
Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
For primary bibliographic entry see Field 5E.
W87-05572

PLANT RECYCLES PROCESS AND HYDRAULIC ENERGY,
Metro Wastewater, San Diego, CA.
D. Thomas.
Water Engineering and Management WENMD2, Vol. 133, No. 12, p 29-30, December 1986.

Descriptors: *Wastewater treatment facilities, *Energy, *Recycling, *Hydroelectric plants, *Sewage gas, *Cogeneration, Methane, California.

The city of San Diego, California, has two facilities to use energy provided by its wastewater treatment operations: a gas utilization facility (GUF) to generate electricity from methane-rich sewage gas and a hydroelectric facility (HEF) to take advantage of the energy of effluent flowing into the Pacific Ocean. Started in 1980, both projects are now on-line and generating electricity. The GUF provides all the electrical power to the wastewater plant and the GUF itself, and yields approx 2.5 MW excess power for sale to the local electric utility. The GUF has generated about $60,000/mo in revenue and displaced the equivalent amount of $40,000/mo electrical bills. The HEF uses a 1.5 MW generator and will provide revenue of $30,000/mo from sales to the local utility when it is fully operational. (Rochester-PTT)
W87-05573

DESIGN ASSUMPTIONS KEY TO EGG-SHAPED DIGESTER COSTS,
Pitt-Des Moines, Inc., Pittsburgh, PA.
J. P. Garvin.
Water Engineering and Management WENMD2, Vol. 133, No. 12, p 31-34, December 1986. 6 fig, 3 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Egg-shaped digesters, *Cost analysis, Mathematical models, Design, Capital costs.

Conventional anaerobic digesters of cylindrical shape are compared with egg-shaped digesters, which have a central spherical section with steep top and bottom cones. The following relationship has been developed between digester volume and installed cost: $y = 2.19\ x$ to the 0.53 power, where y is the installed module cost in millions of dollars and x is the volume of each of two digesters in millions of gallons. With the relationship, the effect of conceptual design assumptions on capital cost could be quantified. Assumptions considered here are: solids concentration in the digester feed, the number of digester stages, the number of digesters per stage, and an allowance for the volume loss due to the accumulation of scum and grit. Using an equation that incorporates all these design assumptions, it is shown that there is a nearly 2:1 capital cost range generated by the choice of design assumptions (best versus worst) at the conceptual stage. The value of the digester gas is another important element to be considered, because it can account for a substantial portion of the capital cost. (Rochester-PTT)
W87-05574

TREATMENT AND DISPOSAL OF WASTES FROM DRY SO2 CONTROL PROCESSES,
Sargent and Lundy, Chicago, IL.
For primary bibliographic entry see Field 5E.
W87-05575

AUTOMATION OF AN ELECTROLYTIC CELL FOR THE TREATMENT OF OILY WASTEWATER,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
F. G. Oblinger, M. Weintraub, E. J. Blais, and R. L. Gealer.
Environmental Progress ENVPDI, Vol. 5, No. 4, p 283-286, November 1986. 6 fig, 2 tab, 7 ref.

Descriptors: *Industrial wastewater, *Oil wastes, *Electrolysis, *Wastewater treatment, *Automation, *Process control, Iron, Turbidity.

An automatic control system was installed and evaluated on a pilot plant for the electrolytic treatment of oily wastewater at an automotive transmission plant. In this continuous process, the wastewater passes through a porous iron chip bed anode where the oil emulsion is demulsified by electrolytically dissolved iron, forming an oil-rich floating sludge and oil-free water. The control system maintains a low effluent oil concentration by adjusting the anode current — and hence the amount of iron dissolved — in response to deviations from a set-point of effluent oil content, as sensed with an in-line turbidimeter. The current automatically assumes the newly demanded value within about 6 to 10 minutes of a step increase or decrease in effluent turbidity. The system controlled the treatment of the widely varying plant wastewater continuously for 30 days, with no intervention or control adjustment and with a minimum of daily maintenance. (Author's abstract)
W87-05576

DISASTER STRIKES CITY OF HERMITAGE TORNADO OF MAY 31, 1985,
For primary bibliographic entry see Field 5G.
W87-05580

AIR DRIVE ROTATING BIOLOGICAL CONTACTORS-PROBLEMS ENCOUNTERED AND SOLUTIONS SOUGHT: PART I,
West Virginia Univ., Morgantown. Dept. of Physics.
W. A. Sack, J. A. Williams, J. C. Cutright, R. G. Neely, and P. M. Soccorsi.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 20, No. 1, p 10-15, January-February 1987. 8 fig, 1 tab.

Descriptors: *Biological contactors, *Maintenance, *Wastewater treatment facilities, *Biofilms, *Hydraulic engineering, Performance evaluation, Temperature, Seasonal variation.

Operational data are presented for the performance of recently-installed air-drive biological contactors at the Morgantown, West Virginia, wastewater treatment plant. The system, which has 36 shafts, with 6 units in each of 6 trains, performed well in the first summer of operation, but rotational speeds began to decrease in the fall and high load cell (LC) readings were observed that winter and continuing into the next spring. Essentially the same pattern of performance occurred in the second year, but uneven shaft rotation or 'loping' was added to the list of difficulties. During January 1984, 80% of the standard shafts treating flow were loping, with two stopped, and 33% of the stage-2 shafts were stopped. Plant loading and biofilm characteristic interrelationships among temperature, LC readings, rotational speed, and loping are discussed here in relation to the observed operational problems. (Rochester-PTT)
W87-05581

USE OF WASTE PICKLE LIQUOR TO PRECIPITATE PHOSPHORUS FROM A MUNICIPAL WASTEWATER,
J. B. Nesbitt, and S. J. Kocher.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 20, No. 1, p 20-25, January-February 1987. 4 fig, 4 tab, 10 ref.

Descriptors: *Water reuse, *Waste disposal, *Recycling, *Performance evaluation, *Metal finishing wastes, *Phosphate removal, *Steel industry, *Wastewater treatment, *Waste pickle liquor, Aeration, Iron, Ferric chloride.

Laboratory studies were conducted to determine the effectiveness of waste pickle liquor (WPL) in removal of P from municipal wastewater and to ascertain which process variables had an effect on P removal. WPL liquor from a steel plant is comparable to commercial ferric chloride in chemical composition. For precipitating P from a municipal activated sludge mixed liquor using WPL, aeration mixing was more effective than slow stir mixing. With aeration mixing, an Fe(2+)/P ratio of 5:1 was the most effective WPL dose. With aeration mixing, a contact time of 5 min produced the best P removal. As contact time increased to 120 min, P removal efficiency decreased slightly. With aeration mixing, 5 min contact time, and 5:1 Fe(2+)/P ratio, total P was reduced from 5.6 mg P/l in an unfiltered, untreated sample to 0.410 mg P/l in an unfiltered treated sample and 0.056 mg P/l in a filtered-treated sample. Soluble orthophosphate was reduced from 4.8 mg P/l in an untreated sample to 0.051 mg P/l in the treated sample. Additional changes in the sample resulting from this treatment included a 0.2-unit drop in pH, 21% decrease in alkalinity, 20% decrease in chemical oxygen demand (filtered sample), increase in total iron concentration, and a decrease in turbidity. (Rochester-PTT)
W87-05582

ANAEROBIC DIGESTION: EFFECTS ON PARTICLE SIZE AND DEWATERABILITY,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. L. Lasler, Y. J. Chung, S.-J. Hwang, and B. A. Hull.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 12, p 1107-1117, December 1986. 9 fig, 4 tab, 24 ref. EPA Grant R-810147-01-0.

Descriptors: *Wastewater treatment, *Wastewater, *Sludge, *Anaerobic digestion, *Sludge digestion, *Sludge drying, *Dewatering, Activated sludge, Digested sludge, Primary sludge, Digestion, Wastewater facilities, Sludge thickening, Particle size, Municipal wastes, Municipal wastewater, Kozeny equation, Mathematical equations.

Anaerobic digestion is commonly used in wastewater treatment plants to stabilize sludge produced in primary and secondary treatment, and to reduce the volume of solids for ultimate disposal. Solid/liquid separation (secondary digestion, thickening or dewatering, or a combination of these) follows anaerobic digestion to complete volume reduction. The effects of anaerobic digestion, including design and operational variables of digesters, on particle characteristics and dewaterability of typical municipal wastewater sludges were studied. Relationships among anaerobic digestion, dewaterability, and sludge particle size distributions were investigated and presented. In laboratory digesters operating variables including detention time, influent solids concentration, and mixture ratio of primary and activated sludge were found to influence digested sludge dewaterability. When working properly, anaerobic digestion destroyed sludge particles of all sizes, but removed small particles preferentially thus reducing specific surface area and improving dewaterability. Specific surface area was the principal determinant of sludge dewaterability, as was expected from the Kozeny equation. (Wood-PTT)
W87-05604

EFFECTS OF MEAN CELL RESIDENCE TIME AND PARTICLE SIZE DISTRIBUTION ON ACTIVATED SLUDGE VACUUM DEWATERING CHARACTERISTICS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, and T. L. Zentkovich.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 12, p 1118-1123, December 1986. 10 fig, 2 tab, 13 ref. EPA Grant R-807149010.

Descriptors: *Dewatering, *Wastewater treatment, *Activated sludge processes, *Sludge, *Activated sludge, *Particle size, Primary sludge, Sludge drying, Drying, Mean cell residence time, Polymers, Cationic polymers, Cations, mathematical equations.

The effects of variations in mean cell residence time on dewatering characteristics of waste activated sludge were assessed. Changes in sludge specific resistance were related to the characteristic size distribution of particles in each sludge. The response of activated sludge samples to the addition of cationic polymer was also considered. The data indicated that the mean cell residence time (theta sub c) had a significant role in the determination of the dewatering characteristics of activated sludge samples; optimum dewatering rates occur at theta sub c values greater or equal to eight days. The correlating factor between theta sub c and sludge specific resistance (r) was the characteristic size of particles in a sludge matrix. Increases in characteristic particle size produced a corresponding decrease in r. Therefore, any operational parameter which produces an increase in particle size might be expected to improve dewatering rates. Cationic polymer dosages requires to optimize activated sludge dewatering rates were a direct function of the size of the particles in the unconditioned sludge. Cationic polymer conditioning of the activated sludge samples was accomplished through interparticle bridging. (Wood-PTT)
W87-05605

RE-EVALUATION OF LAUNDERS IN RECTANGULAR SEDIMENTATION BASINS,
S. Kawamura, and J. Lang.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 12, p 1124-1128, December 1986. 2 fig, 7 tab, 23 ref.

Descriptors: *Wastewater treatment, *Solids, *Settleable solids, *Skimming troughs, *Skimming, *Finger launders, *Hydraulic structures, *Turbidity, *Sedimentation basins, Solid wastes, Escondido-Vista Water Treatment Plant, Basins, Sedimentation, Tracers, Field tests, Statistical analysis.

Sedimentation basin performance with finger launders (skimming troughs) and a simulated transverse overflow end wall were compared under controlled conditions at the Escondido-Vista Water Treatment Plant. A tracer test revealed no significant difference in basin flow characteristics between the two basins. The solids removal efficiency comparisons during a two-month test period indicated that the difference in settled water turbidity averaged about 15% lower with long launders. However, the particle counts and solids removal showed no significant difference between the two launder designs. Overall basin performance was not significantly affected by either the launder geometry or hydraulic weir loading. The sedimentation basins investigated were long and narrow, had a 90-minute hydraulic detention time, and had hydraulic surface loading that was about twice that of ordinary settling basins at the design flow of 1.65 cu m/s; with upflow clarifiers or horizontal flow rectangular basins of different shapes the results may be different. Advantages and disadvantages of long launders were listed and it was concluded that their effectiveness in rectangular flow sedimentation basins is questionable. (Wood-PTT)
W87-05606

HYDRAULIC STUDIES AND CLEANING EVALUATIONS OF ULTRAVIOLET DISINFECTION UNITS,
Montgomery (James M.), Inc., Pasadena, CA.
P. Kreft, O. K. Scheible, and A. Venosa.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 12, p 1129-1137, December 1986. 9 fig, 4 tab, 5 ref. EPA Contract 68-03-1821.

Descriptors: *Wastewater treatment, *Wastewater, *Ultraviolet disinfection units, *Maintenance *Hydraulic systems, *Hydraulics, *Hydraulic design, *Cleaning, Design criteria, Disinfection, Plug flow, Irradiation, Ultraviolet radiation, Radiation, Quartz, Polymers, Fouling, Secondary wastewater.

Hydraulics and cleaning of various types of UV disinfection equipment were evaluated. It was determined that fluorocarbon polymer tube units provide for near plug-flow hydraulic conditions which are desirable in UV units to assure that all water passing through the unit is irradiated equally. Two different types of quartz tube units were evaluated for their hydraulic characteristics and it was found that both exhibited short-circuiting which reduced the actual contact time between the UV light and

the wastewater. Although the tubes were marketed as non-fouling, observations and measurements demonstrated that secondary wastewater caused tube fouling which was sometimes severe. Frequent visual monitoring of the tubes in a unit was recommended to determine the need for cleaning with a high pressure nozzle or swabs. Quartz fouls both chemically and biologically and the rate depends on water quality and whether the UV lamps are on or off. Ultrasonic or mechanical wipers were provided with most quartz units and although the wipers seemed to clean better, neither precluded the necessity for chemical cleaning. It was concluded that designs incorporating UV units should provide for some form of chemical cleaning, preferably a recirculation system. (Wood-PTT)
W87-05607

EFFECTS OF ADVANCED WASTEWATER TREATMENT ON RIVER WATER QUALITY,
Akron Univ., OH. Dept. of Civil Engineering.
M. S. Kennedy, and J. M. Bell.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 12, p 1138-1144, December 1986. 6 fig, 5 tab, 12 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Advanced wastewater treatment, *Water quality, *Model studies, *Water pollution control, *Rivers, Pollutants, Path of pollutants, Indianapolis, White River, Ammonia, Nitrification, Dissolved oxygen, Oxygen, Ozonation, Effluents, Mathematical models, Mathematical equations, Mathematical studies, Benthic demand, Benthic environment.

Implementation of advanced wastewater treatment (AWT) processes in Indianapolis in 1983 substantially improved water quality in the West Fork of the White River. The NH3-N concentrations were reduced and the dissolved oxygen (DO) was increased. Violations of water quality standards were virtually eliminated downstream of the Southport effluent outfall. With the exception of effluent ozonation, the addition of AWT processes had little effect on deoxygenation rates in the river. Changes in river water quality did alter other parameters that affect DO dynamics of White River. The fraction of NH3-N removed from the river increased as NH3-N concentrations decreased. A shift from zero- to first-order nitrification kinetics was proposed as an appropriate modeling approach. The results of calibrating a DO model indicated that benthic demand was the predominant sink in the river before AWT implementation. Improvements in effluent quality associated with AWT addition significantly reduced the benthic respiration rate. (Wood-PTT)
W87-05608

INEXPERIENCED WORKERS INJURY PRONE,
Water Pollution Control Federation, Alexandria, VA.
For primary bibliographic entry see Field 5G.
W87-05609

AVOIDING FINE BUBBLE BREAKDOWN,
Houck (D.H.) Associates, Inc., Silver Spring, MD.
D. H. Houck.
Operations Forum, Vol. 3, No. 12, p 18-21, December 1986. 2 fig.

Descriptors: *Wastewater treatment, *Wastewater, *Sludge, *Aerators, *Hydraulic equipment, *Maintenance, Aeration, Activated sludge, Cleaning, Performance evaluation, Monitoring.

Fine bubble aerators have been installed in many activated sludge process wastewater treatment plants in North America in the last ten years. Properly operated, these diffusers can save money and enhance process performance. Techniques for successful operation and maintenance of fine bubble aeration systems were summarized. Short- and long-term maintenance procedures were described in detail and it was observed that a combination of short-term observation, long-term monitoring, and preventative maintenance produced the best results. In-situ cleaning systems were found to be a major aid to maintenance and it was recommended that they be installed where possible. (Wood-PTT)
W87-05610

LOW-COST LAB WORK,
For primary bibliographic entry see Field 5G.
W87-05611

SLUDGE WASTING,
Salina Area Vocational-Technical School, KS.
For primary bibliographic entry see Field 5E.
W87-05612

AMMONIA INHIBITION OF METHANOGENESIS FROM CATTLE WASTES,
Science and Education Administration, Clay Center, NE. Meat Animal Research Center.
A. G. Hashimoto.
Agricultural Wastes AGWADL, Vol. 17, No. 4, p 241-261, 1986. 6 fig, 9 tab, 20 ref.

Descriptors: *Wastewater treatment, *Animal wastes, *Dairy industry, *Ammonia, *Methane, *Fermentation, Thermophilic bacteria.

Inhibition of anaerobic fermentation by high ammonia concentrations has been reported. Ammonia inhibition of methanogenesis from cattle wastes was studied using laboratory scale, mesophilic and thermophilic fermentors fed beef-cattle manure (40 kg volatile solids per cubic meter) and various levels of 5N NH4Cl. Results showed that ammonia inhibition began at about 2.5 kg N/cu m for both thermophilic and mesophilic fermentations that were not previously acclimated to high ammonia concentrations and about 4 kg N/cu m for thermophilic fermentors previously acclimated to ammonia concentrations between 1.4 and 3.3 N/cu m. This study also showed that assuming steady state after three to four volume turnovers may lead to erroneous conclusions when inhibitory substances are present in the substrate. (Author's abstract)
W87-05877

ELIMINATION OF HYDROGEN SULPHIDE FROM ODOROUS AIR BY A WOOD BARK BIOFILTER,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
H. Van Langenhove, E. Wuyts, and N. Schamp.
Water Research WATRAG, Vol. 20, No. 12, p 1471-1476, December 1986. 3 fig, 4 tab, 14 ref.

Descriptors: *Hydrogen sulfide, *Biofilters, *Wastewater treatment, *Odor control, *Wood bark, Sulfur compounds, Oxidation, Peat, Compost, Microbial degradation, Costs.

Odor reduction is a constant concern of wastewater treatment plant superintendents. Wood bark, used as biofilter material, gives less back pressure than fibre peat or household compost and is therefore cheaper in variable costs than the other materials. With a filter bed height of 0.9 meters and with a surface load of 65 cu m/sq m h, 10 ppm hydrogen sulfide is efficiently eliminated from odorous air by a wood bark biofilter. The most important parameter for good functioning of the filter is the water content of the filter material. The optimum for wood bark is about 65%. Unnecessarily high back pressures are recorded during sprinkling water on top of the filter. Therefore it seems preferable to condition the relative humidity of the air entering the filter. If absorption and adsorption were the only factors in the bio-filter mechanism, hydrogen sulfide would break through in about 7 h. It is shown that hydrogen sulfide is oxidized to sulfate. Literature data reveals that chemical oxidation is too slow and therefore hydrogen sulfide oxidation in the biofilter is attributed to microbiological action (Author's abstract)
W87-05903

EFFECT OF THE ENDOGENOUS PHASE DURATION ON THE MAXIMUM SUBSTRATE REMOVAL RATE IN MIXED CULTURES,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba, P. Chudoba, and J. S. Cech.
Water Research WATRAG, Vol. 20, No. 12, p 1505-1509, December 1986. 6 fig, 4 tab, 8 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Activated sludge process, Optimization, Activated sludge, Aeration, Cultures, Chemical oxygen demand, Biomass.

The maximum substrate removal rates r sub x,m were measured during the endogenous phase by means of a simple respirometric method. Excess biomass from a continuously-fed Completely Mixed (CM) and a Semicontinuously-Fed (SE) reactor was tested with ethyl alcohol, glutamic acid, phenylalanine, acetic acid, phenol, and glucose. It was found with the mixed culture from the CM system that during a 6 h endogenous period the r sub x,m values remained constant for all substrates tested. With the mixed culture from the SE system the values increased during the first 8-12 h of the endogenous period and then decreased. The authors conclude that the respirometric method measuring r sub x,m values can be used to optimize the contact stabilization process. (Author's abstract)
W87-05908

BIOCHEMICAL MODEL FOR ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
Y. Comeau, K. J. Hall, R. E. W. Hancock, and W. K. Oldham.
Water Research WATRAG, Vol. 20, No. 12, p 1511-1521, December 1986. 6 fig, 1 tab, 47 ref.

Descriptors: *Wastewater treatment, *Model studies, *Phosphorus, *Biological wastewater treatment, *Bacterial physiology, *Activated sludge, Aerobic conditions, Anaerobic conditions, Phosphate, Cations, Biological membranes, Carbon.

A biochemical model is presented that explains biological phosphorus (bio-P) removal mechanisms occurring under anaerobic, aerobic, and anoxic conditions of a wastewater treatment process. Observations from the literature are first reviewed and mechanisms of bacterial bioenergetics and membrane transport are summarized. The model for bio-P metabolism is then presented. The role of polyphosphate under anaerobic conditions is suggested to be a source of energy both for the reestablishment of the proton motive force, which would be consumed by substrate transport, and for substrate storage. The role of the anaerobic zone is to maximize the storage of organic substrates in bio-P bacteria (defined as an organism which can store both polyphosphate and carbon, e.g. as poly-beta- hydroxybutyrate). For this purpose the supply of readily available substrates should be maximized and the presence of electron acceptors (molecular oxygen and oxidized nitrogen) minimized. Under subsequent aerobic or anoxic conditions, bio-P bacteria will accumulate polyphosphates in response to the availability of electron acceptors for energy production. Carbon reserves in bio-P bacteria should provide energy for growth and for soluble phosphate accumulation as polyphosphate reserves. Finally, experimental results suggest that K(+), Mg(2+), and Ca(2+) are co-transported across the inner bacterial membrane with polyphosphate molecules. (Airone-PTT)
W87-05909

APPLICATION OF LEAD DIOXIDE-COATED TITANIUM ANODE IN THE ELECTROFLOTATION OF PALM OIL MILL EFFLUENT,
Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Chemistry.
C. C. Ho, and C. Y. Chan.
Water Research WATRAG, Vol. 20, No. 12, p 1523-1527, December 1986. 4 fig, 13 ref.

Descriptors: *Electroflotation, *Industrial wastewater, *Electrodes, *Wastewater treatment, Lead dioxide, Titanium, Electrochemistry, Palm oil, Effluents, Corrosion, Anodes.

The electroflotation of Palm Oil Mill Effluent (POME) was conducted on a laboratory scale, and the lead dioxide-coated titanium anode was found to be corrosion resistant under the experimental conditions. The feasability of the process was determined by monitoring the effluent quality as a function of electrolysis time. Simultaneous flotation of suspended particles and anodic destruction of soluble substances in POME were observed. About 40% of the COD of the dissolved substances of POME could be anodically destroyed, and 86% of suspended particles, composed mainly of plant cell debris, floated off. The highest values were obtained under basic (pH 10) conditions, although rapid initial destruction of COD (almost 30% in 3 h) was observed at pH 4. It is envisaged that the electroflotation process could form the first step of a treatment system with aerobic or physicochemical processing as a secondary treatment step. (Airone-PTT)
W87-05910

NEW RAPID METHOD FOR DETERMINING SLUDGE ACTIVITY,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
J. Olah, and P. Princz.
Water Research WATRAG, Vol. 20, No. 12, p 1529-1534, December 1986. 5 fig, 2 tab, 16 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Biological wastewater treatment, *Process control, Glucose, Automation.

One of the most reliable methods for characterizing an activated sludge is the measurement of its activity. The measuring principle of the method developed here is based on the determination of glucose activity of the activated sludge. The activated sludge sample is continuously aerated in a reactor and glucose standard solution is introduced. Glucose uptake is measured by a glucose-sensitive electrode, and the activity is calculated on the basis of the reaction time required for 50% decomposition of the glucose. Only a change in dissolved oxygen concentration interferes with the measurement, and this interference is eliminated by measurement of the dissolved oxygen. The electrical response of the glucose electrode is corrected by that of the oxygen electrode. The method is selective, and reproducibility is within 10%. The measuring range of the method is 0-200 mg of glucose per g of sludge per hour. The simplicity of the method and of the instrumentation make it applicable to continuous process control. (Airone-PTT)
W87-05911

SULFIDE INHIBITION OF THE METHANOGENIC ACTIVITY OF GRANULAR SLUDGE AT VARIOUS PH LEVELS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
I. W. Koster, A. Rinzema, A. L. de Vegt, and G. Lettinga.
Water Research WATRAG, Vol. 20, No. 12, p 1561-1567, December 1986. 4 fig, 2 tab, 54 ref.

Descriptors: *Wastewater treatment, *Sludge, *Hydrogen sulfide, *Methane bacteria, *Inhibition, *Anaerobic digestion, Hydrogen ion concentration.

Sulfide inhibition of methanogenesis is one of the major factors that have prevented the commercial application of the anaerobic digestion process to the wastewaters of several major industries. The effect of sulfide on the formation of methane from acetate in granular sludge originating from a UASB reactor was determined using a new batch anaerobic toxicity assay. The assay is based on measurement of the methane concentration in the closed head space of a serum bottle, thus allowing operation at constant pH and without loss of sulfide via off gases. Sulfide toxicity appeared to be correlated with the free hydrogen sulfide concentration in the pH range 6.4-7.2. This correlation did not hold at pH = 7.8-8.0. Free hydrogen sulfide concentrations leading to 50% inhibition were 250 mg sulfur/l in the pH range 6.4-7.2, and 90 mg sulfur/l at pH = 7.8-8.0. The high tolerance for sulfide toxicity exhibited by the granular sludge can probably be attributed to the existence of a pH gradient in the sludge granules leading to an increased internal pH. (Author's abstract)
W87-05915

OXYGEN MICROPROFILES OF TRICKLING FILTER BIOFILMS,
Technische Hogeschool Delft (Netherlands). Lab. of Microbiology and Enzymology.
J. G. Kuenen, B. B. Jorgensen, and N. P. Revsbech.
Water Research WATRAG, Vol. 20, No. 12, p 1589-1598, December 1986. 10 fig, 1 tab, 23 ref.

Descriptors: *Biofilms, *Trickling filters, *Wastewater treatment *Oxygen, *Respiration, Photosynthesis, Electrodes, Mathematical analysis, Nutrients, Light quality, Algae.

Oxygen microprofiles of photosynthetic and non-photosynthetic biofilms of trickling filters from a sewage treatment plant were studied with Clark type oxygen microelectrodes. The oxygen profiles in photosynthetic biofilms exhibited pronounced changes with changing light conditions, and the profiles of both types of biofilm were affected by addition of nutrients. The existence of a 100-500 micron thick diffusive boundary layer in the water just above the biofilm was evident from all recordings. The O2 gradient in this boundary layer was used to calculate diffusive fluxes of oxygen exchanged between the biofilms and the overlaying water phase. The calculated values were compared to experimentally measured consumption rates and to the measured photosynthetic activity.Approximately 60-70% of the oxygen produced in the algal films during photosynthesis was consumed within the films. At least a third of this may be due to photorespiration. Dark/light and light/dark shifts demonstrated a very dynamic nature of the O2 status of the algal films, increasing from anaerobic conditions to 500% air saturation and vice versa in 25 min. In the same regime, pH profiles varied between 8.1 and 9.7 within the same period. Data from non-photosynthetic biofilms show that oxygen respiration and oxygen penetration are mostly limited by diffusive oxygen transport through the boundary layer. The overall oxygen consumption of the heterotrophic biofilms was within + or - 10% of the estimates made from flux calculations. (Author's abstract)
W87-05919

5E. Ultimate Disposal Of Wastes

SALINITY CONTROL BENEFITS THROUGH REGULATION OF PRODUCED WATER,
Utah Bureau of Water Pollution Control, Salt Lake City.
J. R. Riding.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 367-375, 1 tab, 26 ref.

Descriptors: *Wastewater disposal, *Industrial wastes, *Brines, *Injection wells, *Evaporation ponds, Brine disposal, Oil industry, Saline water, Regulations, Design standards.

The 1974 estimated daily brine production in the United States from oil and gas production was 30 million barrels with Utah Brine production at approximately 100,000 barrels. By 1981, these production figures had climbed to over 300,000 barrels/day or a three-fold increase in brine production. There are solutions to prevent the pollution of fresh waters and lands, and at the same time satisfactorily dispose of oil field waters. Two effective methods that exist for brine disposal (excluding chemical recovery) are lined evaporation ponds and injection wells. Through the use of public meetings and discussions with oil-field producers and water hauling representatives, concepts for better control for evaporation ponds were crystallized into the 1982 Part VI Wastewater Disposal Regulations. The procedural methods outlined in these regulations detail proper design, construction and operation of produced water surface disposal facilities. With proper siting, design, construction, and monitoring, the surface methods provided will assure that minimal groundwater contamination will take place. The second the more universally applicable method is disposal by means of an injection well. When produced water is injected into wells for disposal, an environmental threat can be avoided if the injection process is carefully planned and executed. Successful disposal requires proper injection well construction, operation, and the availability of permeable formations sufficiently thick to accomodate the brine produced. The major problem which is associated with deep well injection is natural plugging of the well and formation. This plugging problem is commonly caused by salt precipitates, muds, solids, oil, sulfur, or bacteria in the brine. To minimize plugging, the brines are usually treated so they are compatible with the receiving formation fluids. Despite all treatment precautions, the capacity of the disposal well will normally decrease with time. To revitalize the well, remedial measures such as acidizing, hydraulic fracturing, and backwashing, are used. (See also W87-05163) (Lantz-PTT)
W87-05199

ARKANSAS-RED RIVER BASINS CHLORIDE CONTROL PROJECT: TECHNICAL FEASIBILITY STUDIES FOR PLAN OF CONTROL,
Corps of Engineers, Tulsa, OK.
J. H. Roberts.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 377-387, 8 fig, 1 tab, 2 ref.

Descriptors: *Wastewater disposal, *Brines, *Arkansas River, *Red River, *Chlorides, Water quality control, Groundwater pollution, Groundwater quality, Wastewater collection, Surface water collection, Pumping, Crowell Brine Lake, Deep well injection.

Presented is a summary of the chloride contamination problem in the Arkansas and Red River Basins, and an overview of technical feasibility studies necessary to develop a plan of control. Surface water investigations have shown that three separate emission areas exist at Area XIII in the 9-km reach above the Jonah Creek-Red River confluence. Groundwater pump tests have shown that they are also separate hydrologically. Geologic investigations have shown that these three areas are structural basins formed by solutioning of soluble evaporite minerals and subsidence of overyling strata. The principle brine carrier, the Acme dolomite, is either above the water table or is removed by Jonah Creek in the higher areas between the basins. Two types of brine collection methods were considered as viable alternatives at Area XIII. The first method is a subsurface collection plan which would consist of three independent subsurface basins, drilled into the brine aquifer that would collect the emissions before they reach the surface. Emissions would then be pumped to the disposal site. These wells would be pumped at a total rate of 113 L/s and would achieve chloride removal of 336 mg/day. The second method is a surface water collection plan. Brine, after it has reached the surface, is collected through a system of dikes and channels and is directed to a sump where it can be pumped to a disposal site. High fresh water flows down Jonah Creek would pass through a diversion channel, over a low flow dam, and into the Red River. This system would collect an average flow of 116 L/s, and would achieve chloride removal of 354 mg/day. Two methods for brine disposal were studied in conjunction with the collection method mentioned above. The surface disposal method involves pumping the brine approximately 39 km via pipeline to Crowell Brine Lake, a total retention reservoir, located on Canal Creek near Crowell, Texas. As an alternative method, deep well injection was considered for a subsurface disposal system. (See also W87-05165) (Lantz-PTT)
W87-05200

USE OF SALINE WASTE WATER FROM ELECTRICAL POWER PLANTS FOR IRRIGATION,
Utah State Univ., Logan.
For primary bibliographic entry see Field 3C.
W87-05209

U.S. DEPARTMENT OF ENERGY HIGH-LEVEL NUCLEAR WASTE REPOSITORY PROGRAM: GROUNDWATER CONCERNS IN TEXAS,
Texas Governor's Nuclear Waste Program Office, Austin.
S. Frishman.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 353-359.

Descriptors: *Water quality control, *Water pollution prevention, *Groundwater pollution, *Radioactive wastes, Ogallala Aquifer, Aquifers, Santa Rosa Aquifer, Legislation, Costs, Legal aspects.

In 1980, deep geologic disposal of long half-life radioactive wastes was established as the preferred method, and with the January 1983 enactment of the federal Nuclear Waste Policy Act, t6he Department of Energy (DOE) elected to continue investigation of nine sites in the nation which were determined by the Secretary of Energy to be potentially acceptable as repository sites. A function of the Texas Nuclear Waste Programs Office is to coordinate and carry out the interactions between the state, the DOE program, and other involved federal agencies; and to represent the governor in the ongoing state-federal interaction of the repository program. A key provision of the act allows the governor or legislature of a state recommended for a repository, to issue a notice or disapproval of the repository siting, with that disapproval standing as a veto unless it is overridden by a vote of both houses of Congress. The act further provides for extensive financial assistance to states and localities that are under investigation as potential or candidate sites. There is a real possibility that just the perception of soil and water contamination by radioactive materials will have a marked negative impact on the marketability of agricultural products from the area. The two counties in which the potential sites are located were ranked second and sixth in Texas in terms of cash receipts for agricultural products in 1983. The overall view of the DOE high-level nuclear waste repository program, relative to its potential impacts on important sources of underground water, is that the issue has had little serious attention from the program managers regarding the possibility of harmful contamination from both radioactive and nonradioactive sources. There is little evidence in support of the DOE contention that adequate protection of the valuable underground water can be established. (See also W87-05219) (Lantz-PTT)
W87-05242

POTENTIAL GROUNDWATER IMPLICATIONS OF LAND DISPOSAL OF TOXIC SUBSTANCES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, and D. E. Daniel.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 387-402, 1 fig, 6 tab, 29 ref.

Descriptors: *Groundwater pollution, *Land disposal, *Toxic substances, *Waste disposal, Fate of pollutants, Wastewater disposal, Wastewater lagoons, Landfills, Groundwater quality, Leakage, Monitoring, Path of pollutants.

As other waste disposal options, e.g., discharge into rivers, oceans, and the air, have been curtailed by environmental regulations, the amount of waste being disposed on the land has increased. Current disposal techniques include the use of landfills, pits, ponds, lagoons, land treatment, and deep well injection. According to a study by the Environmental Protection Agency, land disposal of hazardous waste during 1981 included 59% by deep well injection, 35% by surface impoundments, 5% or less by landfilling, and 1% by land treatment. There is an increasing body of data from both research and field experience which indicates that in some cases the groundwater quality has been seriously degraded by leakage from land disposal facilities. Scientific and engineering advances will undoubtedly lead to improvement in disposal technologies for hazardous wastes over the next years. However, no scheme is foolproof and no technology is free of risk. Leakages from some facilities are probably inevitable. Given this reality, greater emphasis should be placed on minimizing the amount of toxic material placed in locations where it might eventually leak into the environment. In addition, more emphasis should be given to studying the long-term fate of disposed materials rather than simply focusing on the operational life of the facility and some relatively short postclosure monitoring period. Finally, improved monitoring techniques need to be developed and implemented so that leakages are detected early enough that corrective action can be taken while it is still economically and technically feasible. (See also W87-05219) (Lantz-PTT)
W87-05245

DEEP WELL INJECTION OF INDUSTRIAL HAZARDOUS WASTE IN TEXAS,
Texas Dept. of Water Resources, Austin.
W. B. Klemt.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 403-418, 8 fig, 7 ref.

Descriptors: *Waste disposal, *Industrial wastes, *Deep well injection, *Texas, *Hazardous wastes, Geohydrology, Disposal wells, Wastewater disposal, Regulation, Permits, Legal aspects, Monitoring.

There are about 100 industrial waste disposal wells operating in Texas. The rock units used as disposal reservoirs range in age from Ordovician to Tertiary. The majority of the wells are located on the Gulf Coast and utilize the Tertiary strata. Hydrogeology, reservoir mechanics, well design, seismic risk, compatibility of injected fluid with the receiving formation, and potential hazards to usable groundwater are important aspects and must be evaluated prior to using a waste disposal well. When disposal wells are properly operated they provide safe wastewater disposal. In Texas the record of success of industrial waste disposal wells without a single demonstrated case of usable-quality groundwater contamination is in large part the result of regulation by permit which includes: (1) requiring good casing and cementing practices in well construction; (2) limitations on maximum allowable surface injection pressure and injection rate; (3) evaluation of reservoir properties, geohydrology, and artificial penetration; (4) monitoring of well integrity to detect malfunctions or material failures such as casing, tubing, or packer leaks; (5) record keeping, reporting requirements, and periodic inspection to check for permit compliance; and (6) financial assurance for proper plugging of injection wells upon termination of operations. (See also W87-05219) (Lantz-PTT)
W87-05246

UTILIZATION OF SALT DOMES FOR CHEMICAL-WASTE DISPOSAL,
Texas Univ. at Austin. Bureau of Economic Geology.
S. J. Seni, C. W. Kreitler, W. F. Mullican, and H. S. Hamlin.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 419-460, 20 fig, 2 tab, 20 ref.

Descriptors: *Salt domes, *Waste disposal, *Chemical wastes, *Texas, Caverns, Natural gas, Oils, Leakage, Path of pollutants, Geochemistry, Salts.

Texas salt domes have been proposed as a new type of repository for toxic chemical waste. Nonaqueous waste and solids would be stored in solution-mined caverns within shallow salt diapirs. Nominal cavern shape would be cylindrical to teardrop; diameter 50 to 100 ft; and height 500 to 2,000 ft. Solution-mined caverns have been used for liquid-petroleum gas storage since the 1950s. Presently, liquid-petroleum gas, natural gas, and crude oil are stored in Texas salt domes. The technology envisioned for waste disposal is the same technology used for solution mining storage caverns. However, long-term secure storage exceeding forty years has not been demonstrated. The Texas Department of Water Resources is the state authority that issues permits for waste disposal in Texas. A series of technical issues must be resolved before such disposal is permitted: (1) potential pathways for contaminants leaking from a breached cavern; (2) leakage rates and duration of contamination from a breached cavern; (3) effect of geochemistry and hydrodynamics of lost-circulation zones within cap rocks on long-term stability of casings, cements, and pathways of contaminants; (4) the rates and mechanisms of cavern closure; (5) effects of salt-stock inhomogeneities, flow patterns within salt stocks, cavern depth, and cavern spacing on cavern geometry and stability; and (6) the optimum waste form. (See also W87-05219) (Author's abstract)
W87-05247

GROUNDWATER MONITORING, CONTROL, AND ANALYSIS,
Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W87-05248

SEWAGE SLUDGE COMPOSTING MAINTAINS MOMENTUM,
N. Goldstein.
Biocycle BCYCDK, Vol. 27, No. 10, p 21-22, November-December 1986.

Descriptors: *Surveys, *Waste disposal, *Wastewater treatment, *Sludge, *Composting, Economic evaluation, Costs, Odor control, Municipal wastes, Environmental effects, Compost, Sludge drying.

The number of facilities composting municipal sludge is rising after a dramatic surge between 1983 and 1985. The aerated static pile and windrowing methods are the two most popular techniques for composting, but the in-vessel method appears to be the choice of the future. A survey of compost facilities, state sludge coordinators and equipment vendors was conducted to obtain more detailed information on facility design, equipment, operational problems, markets for compost and operational costs. A rough estimate showed that more than $300 million has or will be spent on building and equipping sludge composting facilities. The cost per ton to compost varied. Many towns had preferred to land apply sludge, but development of agricultural land regulations and a demand for compost made composting more attractive. Odor control, siting and process control were still the primary reasons cited by municipalities for choosing the in-vessel composting option over other methods. Most facilities composted a dewatered or sandbed dried sludge and belt filter presses were the most commonly used dewatering system. Three of the states reporting no facilities last year now have some composting activity. Although the growth in the number of localities choosing composting has slowed due to both the lengthiness of the decision-making process and a wait and see attitude by officials, the number of composting facilities is expected to continue to rise. (Michael-PTT)
W87-05280

NITROGEN AVAILABILITY IN DEWATERED SLUDGE,
Washington County Unified Sewerage Agency, Hillsboro, OR.
M. Pronold.
Biocycle BCYCDK, Vol. 27, No. 10, p 30-31, November-December 1986.

Descriptors: *Sludge drying, *Nitrogen, *Mineralization, *Land disposal, *Sludge utilization, *Sludge disposal, *Nutrients, Monitoring, Groundwater, Leaching, Organic matter, Ammonium nitrate.

Evaluating the amount of nitrogen available for crop growth in sludge is of primary concern to both the sewerage agency and the farmer. If normal agronomic rates are exceeded, groundwater may need to be monitored because because excess nitrogen can be leached into groundwater as nitrate. Nitrogen values for anaerobically digested sludge vary. It is important to determine the mineralization rate of the organic matter fraction of dewatered sludge to evaluate nitrogen values. Experiments were conducted to determine mineralization rates to see if sludge application rates affected the value. A low mineralization rate value initially resulted from poor mixing of the sludge with the soil. Sample preparation was improved and a more fertile soil was used and results indicated that application rates had little effect on mineralization rates. A second experiment showed a larger increase in mineralization rate with more complete sludge incorporation by the soil. The drying process probably allowed more nitrogen to be easily released from the organic matter. It was also noted that the mineralization rate varied widely even using the same sludge. Knowing the variables that affect mineralization and the amount of available nitrogen in sludge is important in any successful land application program. (Michael-PTT)
W87-05281

COMPOSTING PROCESS DESIGN CRITERIA: PART IV-CASE STUDY,
For primary bibliographic entry see Field 5D.
W87-05282

SAVING MONEY WHILE LAND APPLYING,
D. Schauer.
Biocycle BCYCDK, Vol. 27, No. 10, p 40, 42, November-December 1986.

Descriptors: *Economic efficiency, *Sludge utilization, *Land disposal, *Michigan, *Waste disposal, Monitoring, Cadmium, Liquid sludge, Municipal wastes, Ordinances, Local governments, Molybdenum, Heavy metals, Fertilizers, Nutrients.

Wyoming, Mi. saves an estimated seven cents on every dry pound of sludge that goes to farm land rather than an incinerator. Port Huron, Mi. purchased an 80-acre farm for the sole purpose of sludge application, but a neighboring township enacted an ordinance severely restricting land application. A court overturned the law and ruled that townships could not pass ordinances that were more stringent than state rules. Compromises are often reached between state requirements and the stricter rules sought by the townships. One application firm has a full time employee to find application sites and monitor soil conditions. A participation agreement is used to certify that the farmer is aware sludge is being applied to the land, that it contains heavy metals that might limit the amount applied and that there are restrictions on the crops that can be grown on the land. The fertilizer benefits of land application for farmers are apparent, but cities also come out ahead by saving on sludge disposal costs. City operation of land application programs permits greater control and monitoring heavy metals such as cadmium and molybdenum. (Michael-PTT)
W87-05283

WASTE MANAGEMENT IN KOREA,
Environment Administration, Seoul (Republic of Korea).
For primary bibliographic entry see Field 5D.
W87-05284

LIVING NEAR A REFUSE DISPOSAL SITE,
Ibadan Univ. (Nigeria). Dept. of Preventive and Social Medicine.
For primary bibliographic entry see Field 5C.
W87-05285

ANALYSIS OF THE PERCOLATION TEST BASED ON THREE-DIMENSIONAL SATURATED-UNSATURATED FLOW FROM A CYLINDRICAL TEST HOLE,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 2G.
W87-05296

STRATEGIES FOR AERATED PILE SYSTEMS,
Washington Suburban Sanitary Commission, Hyattsville, MD.
For primary bibliographic entry see Field 5D.
W87-05297

SOIL DEODORIZATION SYSTEMS,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
For primary bibliographic entry see Field 5D.
W87-05298

MAKING SLUDGE REUSE MORE SUCCESSFUL,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5D.
W87-05300

SEATTLE'S DIVERSIFIED APPROACH TO SLUDGE USE,
Seattle Sludge Management Program, WA.
P. S. Machno.
Biocycle BCYCDK, Vol. 27, No. 6, p 36-38, July 1986.

Descriptors: *Sludge utilization, *Land disposal, *Waste disposal, *Washington, *Seattle, *Trees, Wastewater management, Water reuse, Forestry, Nutrients, Silvigrow, Recycling.

The Municipality of Metropolitan Seattle Metro) has come up with a method of promoting tree growth that also plays an important role in the agency's water quality program, applying treated sludge to forestland. Metro is responsible for wastewater treatment in the Seattle-King County region and developed the trademark 'Silvi-grow' to describe its use of sludge fertilizer on forests. Metro takes a diversified approach to sludge management, with projects ranging from silvaculture to soil improvement to composting. The agency is now working to develop innovative technologies that can imitate the sucess of its forestry program. (Author's abstract)
W87-05301

ULTRASTRUCTURAL CHANGES IN GILLS OF SAROTHERODON MOSSAMBICUS TREATED WITH CHICKEN MANURE,
Chinese Univ. of Hong Kong, Shatin. Dept. of Anatomy.
For primary bibliographic entry see Field 5C.
W87-05314

ANALYSIS OF RESEARCH NEEDS CONCERNING THE TREATMENT, UTILIZATION, AND DISPOSAL OF WASTEWATER TREATMENT PLANT SLUDGES.
Water Pollution Control Federation, Washington, DC.
Water Pollution Control Federation, Washington, District of Columbia, 1982. 111 p.

Descriptors: *Sludge conditioning, *Research priorities, *Sludge drying, *Sludge disposal, *Wastewater treatment, *Wastewater disposal, Sludge digestion, Biodegradation, Composting, Sludge utilization, Sludge thickening, Dewatering, Wastewater management, Anaerobic digestion, Aerobic digestion, Landfills, Land application, Waste disposal.

Research needs are identified in the area of the quantity and quality of sludge produced by wastewater treatment, the performance of various processes used in sludge treatment, and the ultimate utilization or disposal of residues. The cost of sludge management represents a sizeable portion of the overall costs of wastewater treatment. In addition, the potential environmental impact of sludge disposal is significant, and causes problems for operators of wastewater treatment facilities. Specific topics addressed in the analysis include: fundamental properties of sludges which affect their behavior and biodegradability; sludge production and sources of sludge pollution; sludge treatment processes (thickening, conditioning, dewatering, drying, stabilization, detoxification, thermal conversion, solidification, and reclamation); transportation and storage; ultimate disposal; and sludge management planning and facilities design. The analysis embraces both fundamental and applied research and includes long-term and short term research needs. (Geiger-PTT)
W87-05325

SOLID WASTE MANAGEMENT: SELECTED TOPICS,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
World Health Organization, Geneva, Switzerland, 1985. Edited by Michael J. Suess. 210 p.

Descriptors: Descriptors: *Solid waste disposal, *Land disposal, *Incineration, *Composting, *Animal wastes, *Waste management, Recycling, Waste disposal, Solid wastes, Landfills, Land application, Cost analysis, Waste recovery, Waste storage, Wastewater treatment.

The disposal of solid waste is a problem because it can damage people's health and the environment. One approach to solid waste disposal is to recycle the waste, thus turning waste to profit as well as conserving raw materials. This book brings together much of the expertise that has grown up in waste disposal over the years and discusses it in four chapters: disposal on land; composting; incineration; and animal waste. The first chapter on land disposal explains how to select a site and survey it, what equipment and facilities are needed, what sort of waste is suitable, how to prepare and run the site, and what sort of problems to expect. The next two chapters explain what can be composted or incinerated, how each method works and how to dispoae of the treated waste. The last chapter gives detailed advice about the production, reuse and disposal of animal waste. This book is based on the experience of experts throughout Europe, who at various meetings over the last ten years, have gathered to write, review, and revise these chapters on the treatment and disposal of solid waste. It serves as a guide for public health administrators, sanitary engineers, and all those responsible for the management of solid waste and animal production. (See W87-05327 thru W87-05330) (Geiger-PTT)
W87-05326

DISPOSAL ON LAND (MODEL CODE OF PRACTICE),
Greater London Council (England). Dept. of Public Health Engineering.
P. K. Patrick.
IN: Solid Waste Management: Selected Topics, World Health Organization, Geneva Switzerland, 1985. p 1-36, 7 fig, 1 tab, 33 ref, 3 append.

Descriptors: *Landfills, *Solid waste disposal, *Models, *Project planning, *Land disposal, Waste disposal, Solid wastes, Waste management, Site selection, Cost analysis, Environmental protection, Leaching, Maintenance, Odor.

Discussed is a Model Code of Practice which gives guidelines for the safe and hygienic disposal of crude or untreated waste directly to the land. Topics covered in the Code include: planning and site selection; site survey and operational plan; preparatory works and facilities; types of waste acceptable for disposal in landfills; operational practices; and completion of landfilling and final restoration. The Code covers important factors likely to be met in European countries in planning the disposal of solid waste by landfill. Annexes to the chapter discuss landfill site specifications and economic considerations in the selection and operation of landfill sites, and present a check list for

evaluating landfill operations. (See also W87-05326) (Geiger-PTT)
W87-05327

COMPOSTING,
L. P. Brunt, R. BG. Dean, and P. K. Patrick.
IN: Solid Waste Management: Selected Topics, World Health Organization, Geneva Switzerland, 1985. p 37-77, 2 fig, 5 tab, 27 ref.

Descriptors: *Composting, *Solid waste disposal, *Municipal wastes, *Land disposal, *Waste treatment, Solid wastes, Aeration, Odor, Leachates, Public health, Recycling, Waste disposal, Waste management.

Composting may be used in municipal solid waste disposal to reduce the volume and weight of material to be disposed of, to reduce odors and leachates, and to recover resources. The principles of composting are reviewed along with the range of applicability of municipal waste composting. In general, the batch composting of wastes affords better treatment than continuous composting processes. Crude waste can be composted in heaps or trenches. Methods of treatment of solid waste before composting are discussed. A diagram of a comprehensive composting plant is presented. Composting of prepared waste may be conducted in heaps or wind-rows, in briquette formation, or by forced aeration in heaps or chambers. Control of aeration and odor are discussed. A summary of information about composting plants and processes is given. The health and safety aspects of the use of compost are discussed along with the characteristics, testing, and use of finished compost. (See also W87-05326) (Geiger-PTT)
W87-05328

INCINERATION,
Vrije Univ., Brussels (Belgium). Dept of Chemical Engineering Techniques and Industrial Chemistry.
A. Buekens, and R. K. Patrick.
IN: Solid Waste Management: Selected Topics, World Health Organization, Geneva Switzerland, 1985. p 79-150, 14 fig, 11 tab, 8 ref, 2 append.

Descriptors: *Incineration, *Solid waste disposal, *Sludge disposal, *Waste management, *Waste treatment, Solid wastes, Municipal wastes, Industrial wastes, Waste disposal, Cost analysis, Air pollution, Water pollution, Fly ash.

Incineration of solid waste offers a large reduction in the volume of material requiring final disposal. There are less severe constraints on land disposal of incinerator ash than there are for untreated solid wastes. Incineration can be applied to solid sludge, liquid or gaseous waste. The characteristics of combustible waste are given in terms of the proximate and ultimate analyses and the heat values of waste components. Some typical characteristics of household and commercial waste, industrial waste, sewage sludge and other special waste are presented. The principles of incineration are reviewed. The process flow of a modern municipal incinerator is illustrated. Incinerator emmissions and their collection are considered. The technical options available for incinerator plants include choice of plant size and number of furnace units, grate types, and energy and heat recovery methods. For sludge incineration, the most suitable types of plant are rotating drum incinerators, fluidized beds, or multiple-hearth ovens. Environmental constraints of incineration regarding air and water pollution are discussed. The economics of incineration, positive and negative features of this disposal method, and some new developments in incineration technology are examined. Appendices to the chapter discuss some user specifications and give examples of incinerator plant costs. (See also W87-05326) (Geiger-PTT)
W87-05329

ANIMAL WASTES,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. P. Taiganides.
IN: Solid Waste Management: Selected Topics, World Health Organization, Geneva Switzerland, 1985. p 151-206, 16 fig, 11 tab, 56 ref.

Descriptors: *Solid waste disposal, *Animal wastes, *Feedlot wastes, *Waste management, *Recycling, Biological treatment, Anaerobic digestion, Composting, Aeration, Chemical treatment, Solid wastes, Fertilizers, Manure, Land disposal, Feedlots, Farm wastes, Wastewater treatment.

Potentially successful methods of animal waste management should accomodate reuse of the waste at the point of generation to conserve nutrients and recover energy. Characteristics of animal feedlot wastes and their storage and handling are discussed. Physical treatment of feedlot waste involves sedimentation, screening, centrifuging, filtration, and dehydration. Several biological treatment methods for feedlot wastes (anaerobic lagoons, anaerobic digestion, aerobic ponds, oxidation ditches, aerated lagoons, composting) and chemical treatment methods are discussed. Activated sludge complete treatment plants are now being designed to handle feedlot wastes. An example of a recycling system for treated animal wastes is given. Criteria for selecting the appropriate treatment system for different feedlot sites are presented. Animal wastes are most commonly utilized as fertilizers, energy sources, or nutrient sources for refeeding to animals (coprophagia). Health aspects of land disposal of animal wastes, and application rates and methods are discussed. The costs of waste handling in modern feedlots are considered. The main ecological effect of land disposal of feedlot wastes is nutrient enrichment of natural waters which results in eutrophication. (See also W87-05326) (Geiger-PTT)
W87-05330

LEGAL INCENTIVES FOR REDUCTION, REUSE, AND RECYCLING: A NEW APPROACH TO HAZARDOUS WASTE MANAGEMENT,
For primary bibliographic entry see Field 6E.
W87-05381

NITROGEN MINERALIZATION POTENTIALS OF REVEGETATED LIGNITE OVERBURDEN IN THE TEXAS GULF COAST,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
W. J. Hornby, K. W. Brown, and J. C. Thomas.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 6, p 1484-1489, November-December 1986. 1 fig, 4 tab, 33 ref.

Descriptors: *Mineralization potential, *Lignite, *Overburden, *Mine wastes, *Nitrogen, *Land disposal, *Sludge disposal, *Fertilizers, *Nutrients, Soil columns, Incubation, Anaerobic digestion, Organic matter.

Fresh mine spoil is virtually devoid of organic matter (OM) and N. The needed N is commonly added as inorganic fertilizer; however, sewage sludge additions could supply both OM and N. This study was conducted to compare the mineralizable N resulting from inorganic fertilizer and sludge applications to overburden. Nitrogen mineralization potentials were determined from laboratory data on a pre-mined native soil (Elmina fine sandy loam) and 4-yr old reclaimed mixed overburden that received 180 kg N/ha/yr as NH4NO3 using the Stanford and Smith model (1972). In addition, the effect of anaerobically digested sewage sludge (sludge) on N-mineralization potential of overburden was evaluated on samples collected from field plots. Treatments were as follows: 0 kg N/ha, 212 kg N/ha as NH4NO3, 106 kg N/ha as NH4NO3 plus 106 kg N/ha as sludge, and 212 kg N/ha as sludge applied to 13.8 sq m plots of overburden Soil and spoil samples (0-15 cm deep) were collected from these plots 2 weeks, 26 weeks, and 52 weeks after amendment. Mineralization rates were determined using columns containing 0.2 kg of soil or treated overburden plus 0.1 kg of sand which were incubated for 18 weeks at 35 C. These columns were leached with saturated CaSO4 and a N-free nutrient solution at 0, 2, 6, 10, 14, and 18 weeks and were extracted to a tension of -0.066 MPa after each leaching. The leachate was analyzed for NH4(+) and NO3(-) by colorimetric methods. Application of 56 Mg sludge/ha significantly (alpha = 0.05) increased the total N 26 and 52 weeks after application to levels present in the 4-yr old mineral fertilized reclaimed spoil. Sludge application also resulted in a sustained release of plant available N for 52 weeks after application. Mineralization potentials 2 weeks after the plots were treated were ranked as unamended overburden = NH4NO3 treated overburden < native spoil = 4-year old reclaimed overburden < NH4NO3 plus sludge treated overburden < sludge treated overburden. (Author's abstract)
W87-05415

SLUDGE MANAGEMENT BY THERMAL CONVERSION TO FUELS,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. W. Campbell, and T. R. Bridle.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 5, p 569-574, October 1986. 3 fig, 2 tab, 10 ref.

Descriptors: *Sludge disposal, *Sludge utilization, *Sludge, *Fuel, *Wastewater treatment, *Waste disposal, *Waste management, *Costs, Environmental protection, Activated sludge, Primary sludge, Performance evaluation, Technology.

The philosophy of sludge management in the sewage industry must respond to changes in processing costs and environmental requirements. As overall costs continue to increase, the efficiency of sludge management must be increased either by upgrading the existing system or introducing new technology. Both of these approaches were briefly discussed and it was pointed out that low-temperature conversion of sludge to fuel appears to have considerable potential as a viable new technology. Experimental work carried out at Environment Canada's Wastewater Technology Center used batch and continuous reactors to evaluate this technology at bench scale. Tests on a number of mixed raw sludges (primary and waste activated) resulted in the following yields: oil 22-25%, char 50-60%, noncondensable gas 10-12%, and reaction water 5-12%. The impact of a number of sludge treatment alternatives, including the conversion of sludge to oil, are discussed with respect to energy efficiency, flexibility, and public acceptance. The future plans of Environment Canada for the development and demonstration of sludge-to-oil technology are also discussed. (Author's abstract)
W87-05469

ANAEROBIC TREATMENT OF HIGH-SULFATE WASTES,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-05471

STATISTICAL METHODS FOR CALCULATING EFFLUENT DISCHARGE CONSENTS,
For primary bibliographic entry see Field 5G.
W87-05566

JET BEHAVIOUR IN SHALLOW RECEIVING WATER,
James Cook Univ. of North Queensland, Townsville (Australia).
For primary bibliographic entry see Field 8B.
W87-05567

NEIGHBORLY HABITS AFFECT HOW EUROPE HANDLES SLUDGE,
International Construction, Sutton (England).
M. Monro.
Water Engineering and Management WENMD2, Vol. 133, No. 12, p 21-24, December 1986.

Descriptors: *Waste disposal, *Sludge disposal, *European Economic Community, Aerobic treatment, Sludge stabilization, Landfills, Land disposal, Land reclamation, Standards, Ocean disposal, Incineration.

Almost every European country now has some form of standard regarding the discharge of effluents and the disposal of sludge; many are now members of the European Economic Community (EEC), which has as one of its aims the harmonization of standards among its members. By no means all the sewage generated ends up in municipal sewage plants. The total amount of sludge produced approximates 7 million tons dry solids, with Germany the largest producer (2.2 million tons), followed by the United Kingdom (1.5 million tons), France (840,000 tons), and Italy (800,000 tons). About 70% of the sludge receives some form of stabilization; anaerobic methods are used to deal with about two-thirds of the production. Aerobic methods are favored in the Scandinavian countries and the Netherlands. The most used ultimate disposal methods are landfill or land reclamation (which account for about 75% of Europe's sludge). Ocean disposal (7%) and incineration (8%) are other methods employed. (Rochester-PTT)
W87-05571

SLUDGE DISPOSAL THINKING SIMILAR IN U.K., U.S.,
Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
J. Davis, and D. Garvey.
Water Engineering and Management WENMD2, Vol. 133, No. 12, p 25-28, December 1986. 3 tab.

Descriptors: *Waste disposal, *Sludge disposal, *Land disposal, *Landfills, *Incineration, *Ocean disposal, Metals, Soil pollution, Commission of European Communities, Land reclamation, Forestry, Fuels, England, United States.

Approaches to sludge disposal in the United Kingdom are discussed and compared with sludge disposal practices in the United States. Spreading on agricultural land, sea disposal, landfilling, and incineration are considered, including comparative costs, soil loading rates recommended for metals in sludge, Commission of European Communities limits for metals in soil and sludge, and future responses to environmental pressures. Among the options discussed as alternatives to present sludge disposal practices are land reclamation and forestry, composting, low-sludge sewage treatment process, and manufacture of fuel products. (Rochester-PTT)
W87-05572

TREATMENT AND DISPOSAL OF WASTES FROM DRY SO2 CONTROL PROCESSES,
Sargent and Lundy, Chicago, IL.
S. M. Katzberger, and W. J. Rymarczyk.
Environmental Progress ENVPDI, Vol. 5, No. 4, p 234-239, November 1986. 1 fig, 4 tab, 27 ref.

Descriptors: *Waste disposal, *Wastewater treatment, *Sulfur dioxide, *Air pollution, *Solid wastes, *Fly ash, *Landfills, Flue gas desulfurization, Hydration reactions, Acid rain, Fluidized bed combustion, Furnace sorbent injection, Marketing.

Sulfur dioxide control processes that produce dry wastes include flue gas desulfurization (FGD), fluidized-bed combustion (FBC), and furnace sorbent injection (FSI). The chemical composition and physical properties of the waste products from dry SO2 control processes are discussed, and environmental impacts from dry waste products, landfill site design, waste handling, and waste utilization are described. SO2 control processes that produce dry waste products are being applied to both utility and industrial boilers. The wastes generated by these processes, which typically contain large quantities of coal ash, can be treated and disposed of using techniques similar to current practice for coal fly ash. An important difference between fly ash and the dry SO2 control waste products is the increased lime content of the wastes and the resulting hydration reactions (for FSI and FBC), which occur when water is added. These properties, however, should increase the marketability of wastes from dry SO2 control processes. (Rochester-PTT)
W87-05575

USE OF WASTE PICKLE LIQUOR TO PRECIPITATE PHOSPHORUS FROM A MUNICIPAL WASTEWATER,
For primary bibliographic entry see Field 5D.
W87-05582

ANAEROBIC DIGESTION: EFFECTS ON PARTICLE SIZE AND DEWATERABILITY,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-05604

EFFECTS OF MEAN CELL RESIDENCE TIME AND PARTICLE SIZE DISTRIBUTION ON ACTIVATED SLUDGE VACUUM DEWATERING CHARACTERISTICS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-05605

SLUDGE WASTING,
Salina Area Vocational-Technical School, KS.
T. Hobson.
Operations Forum, Vol. 3, No. 12, p 25-29, December 1986. 4 tab.

Descriptors: *Sludge excess, *Sludge solids, *Wastewater treatment, *Wastewater, *Activated sludge, *Mathematical equations, *Effluents, Sludge, Calculations, Wastes, Wastewater facilities, Solids, Mixed liquor solids, Settleable solids, Bacteria, Foaming, Frothing, Oxygen requirements, Nutrient requirements.

The method for controlling the sludge mass in the treatment system is wasting. The level of solids in the system determines the rate at which sludge needs to be wasted. Sludge wasting rates affect the growth rate of the bacteria, oxygen consumption, settlability of the mixed liquor, occurrence of foaming and frothing, nutrient quantities required, and the quality of the final effluent. Formulas and sample calculations were presented for determining the amount of sludge to waste to maintain the correct amount of bacteria in the activated sludge system. (Wood-PTT)
W87-05612

INFLUENCE OF MICROBIAL ADAPTATION ON THE FATE OF ORGANIC POLLUTANTS IN GROUND WATER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W87-05629

CHARACTERIZING THE AEROBIC AND ANAEROBIC MICROBIAL ACTIVITIES IN SURFACE AND SUBSURFACE SOILS,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
For primary bibliographic entry see Field 5B.
W87-05630

MULTIDISCIPLINARY APPROACH TO THE ASSESSMENT OF OCEAN SEWAGE SLUDGE DISPOSAL,
EA Engineering, Science, and Technology, Inc., Sparks, MD.
J. A. Fava, W. L. McCulloch, J. J. Gift, H. J. Reisinger, and S. E. Storms.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 831-840, 1985. 1 fig, 6 tab, 22 ref.

Descriptors: *Sludge disposal, *Waste disposal, *Ocean dumping, *Water pollution effects, *Bioaccumulation, *Toxicity, *Risk assessment, *Model studies, Hazards, Water quality, Sludge.

A multidisciplinary approach to assess the hazards of ocean sewage sludge dumping is presented. It combines physical and chemical sludge characteristics, estimated safe chronic levels and bioaccumulation potential with estimated environmental exposure (concentration and time) information. The hazard assessment was used to evaluate sewage sludges from 12 water pollution control plants operated by the New York City Department of Environmental Protection. Using a mathematical dispersion model, the worst-case minimum dilution after 4 h was predicted to be 11,500:1. Of the three marine species tested, mysid shrimp were found to be the most sensitive. Using an application factor of 0.05, estimated chronic safe levels were estimated; the values do not exceed the limiting permissible concentrations, after allowing for initial dilution. Also, the concentrations of the chemicals in the liquid sewage sludge phase were below ambient water quality criteria. The results suggest that the ocean disposal of sewage sludge does not appear to present the environmental hazard originally perceived. (Author's abstract)
W87-05641

ARTHROPODS ASSOCIATED WITH PESTICIDE LEACH LINES IN SELECTED ORCHARDS IN CENTRAL NEW YORK,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY.
P. B. Baker, E. R. Hoebeke, J. Barnard, and T. D. Spittler.
Environmental Toxicology and Chemistry ETOCDK, Vol. 5, No. 1, p 61-68, January 1986. 1 fig, 5 tab, 16 ref.

Descriptors: *Arthropods, *Pesticides, *Leaching, *Orchards, *Waste disposal, *Path of pollutants, Agriculture, Taxonomy, Seasonal variation, Farming, Organic compounds.

Chemical control centers were constructed on selected farms in Wayne County, New York, to minimize pesticide pollutants. These centers provided areas where several classes of agricultural chemicals, primarily those from spray operations, could be handled and disposed of safely. We surveyed the arthropod fauna found above the pesticide leach lines and in adjacent soils. Of the 70 arthropod taxa determined, we identified the following families: Diptera (18 families), Hymenoptera (12), Coleoptera (7), Hemiptera (3), Homoptera (1) and Thysanoptera (1). Seasonal comparisons of arthropods above the pesticide leach lines and in the checks showed no apparent differences. Slight taxa variations were observed within and between farms with chemical control centers. No residues greater than 0.2 ppm were found in either water or soil samples. These results imply that no contamination of the environment was caused by the use of the chemical control centers. (Author's abstract)
W87-05645

LANDFORM MODIFICATIONS AT A NUCLEAR-WASTE BURIAL SITE,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W87-05766

MOVEMENT OF DREDGED SAND AT THALWEG DISPOSAL SITES,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 2J.
W87-05826

5F. Water Treatment and Quality Alteration

APPROPRIATE TECHNOLOGY FOR THE TREATMENT OF WASTEWATERS FOR SMALL RURAL COMMUNITIES.
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5D.
W87-05322

TRAINING OF SANITARY ENGINEERS IN EUROPE.
World Health Organization, Copenhagen (Den-

mark). Regional Office for Europe.
For primary bibliographic entry see Field 5G.
W87-05331

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 1, RECOMMENDATIONS.
World Health Organization, Geneva (Switzerland).
World Health Organization, Geneva, Switzerland, 1984. 130 p.

Descriptors: *Water quality standards, *Public health, *Drinking water, *Water treatment, Water quality, Water quality management, Bacteria, Viruses, Water supply, Monitoring, Protozoa, Toxicity, Water pollution effects, Organoleptic properties, Radioactive wastes.

Guidelines developed by the World Health Organization to describe the quality of water that is suitable for drinking purposes under all circumstances are presented. The guidelines are intended to be applied when developing national standards, not only for community piped-water supplies but also for drinking water obtained from community standpipes and wells and drinking water distributed by tankers or in bottles. The guidelines can serve as a basis for developing standards for water supplies serving transient populations. The guidelines may also be of assistance in developing alternative control procedures when the implementation of standards is not feasible. Guidelines are recommended for bacteria, viruses, protozoa, helminths, other free living organisms, chemical contaminants, organoleptic properties, radioactive materials, and the monitoring of these factors. Remedial measures are given for unsafe levels of certain constituents in drinking water. A cost-benefit analysis is presented for the laboratory monitoring of microbial contaminants in relation to public health. A list of participants who prepared the guidelines, tables for determining the most probable number of particular organisms present in 100 ml of water, and some units and terms used in radiation protection are appended to the report. (See also W87-05333 and W87-05334) (Geiger-PTT)
W87-05332

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 2, HEALTH CRITERIA AND OTHER SUPPORTING INFORMATION.
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 5G.
W87-05333

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 3, DRINKING-WATER QUALITY CONTROL IN SMALL-COMMUNITY SUPPLIES.
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 5G.
W87-05334

CONTROL PARAMETER MODEL SPEEDS WATER TREATMENT CALCULATIONS,
J. O. Thaler, and P. K. Sinha.
Power Engineering POENDL, Vol. 90, No. 11, p 31-32, November 1986. 2 fig, 3 ref.

Descriptors: *Boiler water, *Model studies, *Water treatment, *Mathematical models, *Mathematical analysis, *Mathematical equations, Phosphates, Hydrogen ion concentration, Acidity, Sodium, Chemistry, Chemical reactions.

Coordinated phosphate-pH control has long been a common method of boiler water treatment. During normal conditions, this involves addition of sodium phosphates in correct proportions so that disodium phosphate is available to transform potentially corrosive caustic into relatively harmless trisodium phosphate. The Na:PO4 ratio used in this treatment is determined from boiler water pH and phosphate concentration by reference to empirical charts and graphs. The chemistry of the process is discussed and a mathematical model is presented for determining the ratio without charts or graphs. The model is applicable to programmable calculators or computers. (Doris-PTT)
W87-05347

WATER REQUIREMENTS IN ANIMAL HUSBANDRY (DER BEDARF AN TRANK- UND BRAUCHWASSER IN DER TIERHALTUNG),
Tieraerztliche Hochschule Hannover (Germany, F.R.). Inst. fuer Tierhygiene.
For primary bibliographic entry see Field 6D.
W87-05369

BEHAVIOUR-ADAPTED DRINKING WATER SUPPLY IN CATTLE AND SWINE (VERHALTENSANGEPASSTE TRINKWASSERVERSORGUNG VON RINDERN UND SCHWEINEN),
Technische Univ. Muenchen (Germany, F.R.). Landesanstalt fuer Landtechnik.
For primary bibliographic entry see Field 6D.
W87-05370

HEALTH RISKS BY BACTERIAL CONTAMINATION OF DRINKING WATER FOR DOMESTIC ANIMALS AND PROPOSED BACTERIOLOGICAL STANDARDS FOR WATER QUALITY (BAKTERIENBEDINGTE RISIKEN BEIM TRANK- UND BRAUCHWASSER UND VORSCHLAGE FUR STANDARDS),
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Tiermedizin und Tierhygiene.
R. Bohm.
Deutsche Tierarztliche Wochenschrift, Vol. 93, No. 7, p 289-291, July 1986. 4 fig, 3 tab, 25 ref.

Descriptors: *Bacteria, *Contamination, *Drinking water, *Domestic animals, *Risks, *Standards, *Water quality, Germany, Epidemiology, Livestock, Pathogenic bacteria, Groundwater.

Water is an important vector for bacterial pathogens. Since there are no specially designed standards for drinking water quality for domestic animals in the Federal Republic of Germany, it is suggested that the same standards as for municipal drinking water should be applied, corresponding to the requirements of the 'Trinkwasserverordnung'. Surface water should not be used for farm animals, because it is often highly contaminated with bacteria. The importance of the water supply system for animals for the secondary contamination is discussed, and possible methods for disinfection and conservation are described. (Author's abstract)
W87-05371

RISKS FOR DRINKING AND APPLIED WATER CONDITIONED BY VIRUSES AND SUGGESTION FOR STANDARDS (VIRUSBEDINGTE RISIKEN BEI TRANK- UND BRAUCHWASSER UND VORSCHLAGE FUR STANDARDS),
Munich Univ. (Germany, F.R.). Fachbereich Medizin.
H. Mahnel.
Deutsche Tierarztliche Wochenschrift, Vol. 93, No. 7, p 292-294, July 1986. 2 fig, 5 tab, 8 ref.

Descriptors: *Risks, *Drinking water, *Viruses, *Standards, *Public health, *Water quality management, Enteroviruses, Infection, Coxsackie virus, Cattle, Hogs, Poultry.

Viruses are unable to multiply in water, where they become extremely diluted and inactivated. The probability of contagious pathogenic viruses reaching a susceptible host in quantities sufficient for infection is extremely low. Only enteric viruses excreted in high concentrations seem to be important. Risks for drinking water occur through secondary rather than primary contamination. Virological standards are not defensible at present on account of risks and technical means. Water can be considered unobjectionable when corresponding to current hygienic bacteriological standards. (Author's abstract)
W87-05372

HYGIENIC ASPECTS OF WATER USED AT DAIRY FARMS (ZUR HYGIENE DES BRAUCHWASSERS BEI DER MILCHERZEUGUNG),
Tieraerztliche Hochschule Hannover (Germany, F.R.). Inst. fuer Hygiene und Technologie der Milch.
H.-U. Wiesner.
Deutsche Tierarztliche Wochenschrift, Vol. 93, No. 7, p 294-298, July 23, 1986. 3 fig, 2 tab, 10 ref.

Descriptors: *Dairy industry, *Drinking water, *Water quality, *Milk, *Germany, *Contamination, *Livestock, Standards, Water pollution, Bacteria, Risk, Disinfection, Water use, Water demand, Cattle, Domestic animals, Animal diseases, Diseases.

Dairy farms are food-producing institutions according to the German Food Law (LMBG). These institutions must use water of drinking water quality according to the German regulation for production, treatment, and storage of milk. The drinking water supplies for the herd on the farm and on the pasture have to be evaluated separately. The water requirement for cleaning and disinfection is discussed, especially the significance of residual water (adhesive film of water) for the development of pseudomonads as indicators of psychotropic bacteria between milkings. The disadvantages of plastic tubings are discussed. A hygienic risk from chemical and microbial contamination by use of water following the regulations for drinking water is not given for heat-treated milk and products from pasteurized milk. (Author's abstract)
W87-05373

PARASITE-DERIVED HAZARDS FOR CATTLE, SWINE AND POULTRY FROM WATER USED FOR DRINKING AND CLEANING PURPOSES (PARASITENBEDINGTE RISIKEN FUR RINDER, SCHWEINE UND HUHNER DURCH TRANK- UND BRAUCHWASSER),
Giessen Univ. (Germany, F.R.). Inst. fuer Parasitologie.
H.-J. Burger.
Deutsche Tierarztliche Wochenschrift, Vol. 93, No. 7, p 298-300, July 23, 1986. 1 tab, 18 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Parasites, *Animal diseases, *Risk, *Cattle, *Hogs, *Poultry, *Drinking water, Diseases, Protozoa, Farms, Contamination, Infection, Water quality control, Standards.

The potential hazards of infections with protozoa and helminths for cattle, swine, and poultry originating from water used for drinking and cleaning purposes are surveyed. The sources of contamination of the water (on the farm, off the farm, by intermediate hosts, by sewage) are separately discussed. References that prove infections via the drinking water are listed. An estimate of the risk is not possible due to a lack of data. Suggestions are made for minimizing parasitic infections of farm animals via the drinking water. (Author's abstract)
W87-05374

FLOCCULATION AND FILTRATION OF THE GREEN ALGAE CHLORELLA SP. AND DICTYOSPHAERIUM SP. UNDER SELECTED CONDITIONS,
Institute of Public Health, Tokyo (Japan). Dept. of Public Health Practice.
S. Kunikane, B. Lusse, O. Hoyer, and H. Bernhardt.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 4, p 145-151, August 1986. 9 fig, 3 tab, 7 ref. German Ministry of Research and Technology Project 02 WT 372.

Descriptors: *Water treatment, *Drinking water, *Chlorophyta, *Flocculation, *Sand filters, *Filtration, *Algae, Water pollution, Algal density, Agglomeration times, Organic matter, Reservoirs, Cultures.

The removal of two species of green algae, which normally occur in reservoirs for drinking water supply, were investigated using continuous flocculation with Fe(3+) and sand filter filtration on a

laboratory scale. The varied parameters were: culture age (growth phase), algal density in the raw water, Fe(3+) dosage, and agglomeration time. The properties of the cell surface were found to be of great importance. With suspensions of Dictyosphaerium (DI) richly surrounded with extracellular organic matter (EOM), termination of the filter-run was always due to clogging of the filter, whereas the contrary was found with Chlorella (CH) covered with a compact EOM-layer, which caused termination of filter-run due to increasing breakthrough of turbidity. Proceeding culture age causes significant changes in algal surface properties. Hence, a decrease of filter-run time with culture age was found with DI, while with CH an increase was observed. Reduction of the algal density in the raw-water or the dosage of flocculant resulted in an improvement of filter-run time and residual turbidity with CH (reduced filter-loading). In contrast, with DI an optimum Fe(3+) dosage could be found, which, depending on algal density, effected partial deep bed filtration with a minimum of clogging. Prolonged agglomeration time showed a positive effect for DI on filtration efficiency (floc filtration favorable), whereas with CH, omission of the agglomeration step gave better filtration efficiency showing that flocculation filtration (i.e. formation of affixed flocs in the filter bed) was the better method in this case. (Author's abstract)
W87-05457

OPTIMIZATION OF THE ELIMINATION TURBIDITY FROM WATER BY FLOCCULATION IN A CASCADE OF TWO STIRRED REACTORS (OPTIMIERUNG DER TRUBSTOFFREDUZIERUNG DURCH FLOKKULATION IN EINER ZWEISTUFIGEN RUHRREAKTORKASKADE),
L. Meyer, and U. Weismann.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 4, p 152-160, August 1986. 7 fig, 1 tab, 17 ref.

Descriptors: *Water treatment, *Stirred reactors, *Optimization, *Flocculation, *Turbidity, *Model studies, *Mathematical models, Mathematical studies, Mathematical equations, Shear stress, Stress, Kinetics, Performance evaluation.

A flocculation model is described which takes into consideration both the formation and decay rate of flocs caused by shear stresses during the flow through a completely mixed reactor. Some comments are given for the determination of the kinetic coefficients by experiments. The flocculation for a cascade of reactors is discussed. For a cascade with two stages a calculation method is presented giving optimal values of reactor volumes and energy inputs for both stages and maximal effective flocculation rates. The application of this method is demonstrated. (Author's abstract)
W87-05458

INVESTIGATIONS FOR CHEMICAL REACTION OF A HIGH-GRADE STEEL WITH BERLIN DRINKING WATER (UNTERSUCHUNGEN ZUM CHEMISCHEN VERHALTEN VON EDELSTAHL IN BERLINER TRINKWASSER),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 5B.
W87-05460

RADIATION-CHEMICAL DEGRADATION OF TRACES OF TRICHLOROETHYLENE AND PERCHLOROETHYLENE IN DRINKING WATER (DER STRAHLENCHEMISCHE ABBAU VON TRICHLORATHYLEN- UND PERCHLORATHYLENSPUREN IN TRINKWASSER),
P. Gehringer, E. Proksch, W. Szinovatz, and H. Eschweiler.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 5, p 196-203, October 1986. 9 fig, 4 tab, 11 ref. Fonds zur Forderung der wissenschaftlichen Forschung Projekt P5130.

Descriptors: *Water treatment, *Fate of pollutants, *Water purification, *Drinking water, *Chemical reactions, *Radiochemical degradation, *Degradation, *Degradation products, *Trichloroethylene, *Perchloroethylene, *Gamma radiation, Pollutants, Pollutant identification, Irradiation, Nitrates, Chlorine, Chlorides.

The degradation by gamma irradiation of traces of trichloroethylene and perchloroethylene in water samples was investigated over a wide range of concentrations. In general, the higher the concentration of organic and inorganic substances (especially nitrates) dissolved in the water, the slower the degradation. For pollutant concentrations up to about 500 ppb and for drinking water with low nitrate content, the degradation follows a first-order rate law. For higher concentrations of pollutants and/or nitrates, a much more complex behavior is observed. In general, perchloroethylene is degraded more slowly than trichloroethylene. During degradation, organic chlorine is converted quantitatively to chloride ions. Unfortunately, as a side reaction nitrate is partially reduced to nitrite. Except for that, rough estimates of costs indicate that this process is quite attractive. (Author's abstract)
W87-05463

CHLORINATING POULTRY CHILLER WATER: THE GENERATION OF MUTAGENS AND WATER RE-USE,
Western Regional Research Center, Berkeley, CA.
For primary bibliographic entry see Field 5B.
W87-05551

CANCER MORTALITY AND THE METHOD OF CHLORINATION OF PUBLIC DRINKING WATER: ST. LOUIS CITY AND ST. LOUIS COUNTY, MISSOURI,
Missouri Univ.-Columbia. Environmental Health Surveillance Program.
C. J. Marienfeld, M. Collins, H. Wright, R. Reddy, and G. Shoop.
Journal of Environmental Pathology, Toxicology and Oncology JEPOEC, Vol. 7, No. 1/2, p 141-158, September-December 1986. 4 tab, 9 ref. EPA Grant R805297.

Descriptors: *Water pollution effects, *Trihalomethanes, *Cancer, *Mortality, *Drinking water, *Chlorination, *Water treatment, *Trend analysis, Human diseases, Missouri, Epidemiology.

The 'all cancer' and most organ-specific cancer mortality rates have been consistently and considerably higher for St. Louis City than for St. Louis County for the period 1960 through 1972, although the two areas share the same drinking water source (Missouri River). A change in the St. Louis County water treatment process, which included increasing the chlorine dosage and delaying addition of ammonia to form chloramines until just prior to distribution, was instituted in 1955. St. Louis City continued the lower chlorine level and early ammoniation. Trend analysis using the period 1960-67 and 1972-76 showed higher percentage as well as net cancer mortality rate per million increases for large bowel, liver, and bladder cancers for St. Louis County. An apparent association between a probable increase in trihalomethane production in the St. Louis County water since 1955 and an increase in these specific cancers exceeding the increases in St. Louis City were shown. This does not imply causality but agrees generally with other studies that have examined water chlorination and cancer mortality. (Author's abstract)
W87-05555

PLANT SCALE TRIAL OF ON SITE ELECTROLYTIC CHLORINATION,
Department of Housing and Urban Development, Washington, DC.
J. E. T. Strickland.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 40, No. 5, p 389-408, October 1986. 8 fig, 3 ref.

Descriptors: *Chlorination, *Electrolysis, *Water treatment facilities, *Water treatment, *Cost analysis, England, Economic impact, Engineering, Performance evaluation.

Evaluation of on-site electrolytic chlorination (OSEC) equipment and its performance was conducted at the Ogston Water Treatment Works (Severn-Trent Water Authority, England). The present report was completed after 6 mo operational experience with OSEC and covers the following topics: a description of the trial site and the OSEC process, the theory of operation and system engineering, operating conditions, efficiency considerations and factors affecting system performance, and the broad economic implications of the OSEC system. Although the trials are incomplete, they provide encouraging data regarding the reliability of the OSEC process. The economics of the plant have exceeded the manufacturer's claims and in revenue terms prove to be competitive with liquid chlorine in drums. (Rochester-PTT)
W87-05558

DRINKING WATER ADDITIVES PROGRAM,
For primary bibliographic entry see Field 5G.
W87-05570

DRILLERS AND WATER TREATMENT: A MARRIAGE MADE IN HEAVEN,
S. Hurlburt.
Water Well Journal WWJOA9, Vol. 40, No. 11, p 45-51, November 1986.

Descriptors: *Well drilling, *Water conditioning, *Marketing, *Water treatment, *Water quality, Surveys, Training.

Comments from well drillers and from firms providing water conditioning equipment are presented to give the well driller considering offering water conditioning a picture of the state of the water treatment market. Well drillers from North Carolina, Pennsylvania, Texas, Michigan, and Illinois have varying degrees of involvement in the water conditioning business. Training and sales procedures of Water Soft and Chemical Engineering are described. From both the installer and dealer perspectives, the future of water treatment looks both lucrative and promising according to the author. (Rochester-PTT)
W87-05577

UPDATE ON COMMON WATER TREATMENT METHODS,
Water Quality Association, Lisle, IL.
L. Cole.
Water Well Journal WWJOA9, Vol. 40, No. 11, p 58-60, November 1986.

Descriptors: *Water treatment, *Water softening, Water supply systems, Hydrogen ion concentration, Acid water, Water purification, Iron, Manganese, Chlorination, Neutralizing filters, Soda ash, Hardness.

Sources of water supply problems are discussed with suggested methods for dealing with these problems. The conditions and the methods to be employed with them are as follows: ferrous iron (cation ion-exchange water softener, chlorination with time for oxidation, oxidizing filter, chlorination followed by filtration and dechlorination), ferric iron (manganese greensand filter, continuous chlorination followed by an oxidizing filter), iron bacteria (shock chlorination with subsequent continuous chlorination followed by an activated carbon filter), manganese (same methods as for iron), hydrogen sulfide (oxidizing filter, use of oxidizing agents for chemical treatment including chlorination), acid water (neutralizing filters using either calcium carbonate or magnesia oxide or a chemical feed system using soda ash, followed by water softening to correct the hardness brought on by the pH treatment). (Rochester-PTT)
W87-05578

PREDICTING THE OCCURRENCE OF 228RA IN GROUND WATER,
Research Planning Inst., Inc., Columbia, SC.
For primary bibliographic entry see Field 5B.
W87-05584

BALANCING THE RISKS: LEGIONELLA PNEUMOPHILA PNEUMONIA AND TAP WATER SCALDS IN THE HOME,
Manitoba Univ., Winnipeg. Dept. of Social and Preventive Medicine.
R. S. Stanwick.
Canadian Medical Association Journal CMAJAX, Vol. 135, No. 11, p 1251-1252, December 1986. 24 ref.

Descriptors: *Risk assessment, *Water quality, *Water supply systems, *Water treatment, *Water temperature, *Diseases, *Human diseases, *Domestic water, *Heated water, Infection, Water conditioning, Water quality control, Water users, U.S.A., United Kingdom, Hospitals, Bacteria.

The disease produced by Legionella pneumophila, a ubiquitous water-related organism, was first recognized in people exposed to contaminated air produced by regulating devices which depend on water: cooling towers, air conditioners, and evaporative condensers. Outbreaks of the disease were later correlated to the susceptibility of the host organism since immunocompromised hospital patients in the U.S.A. and the United Kingdom contracted the disease through the institutional water supply systems. It has been found previously that water above 32 C was more likely to contain L. pneumophila and that multiplication is enhanced when the temperature is between 55 C and 60 C. The number of bacteria was reduced above 60 C. However, increasing domestic water settings to this level is not recommended because the risk of severe burns is greater than the likelihood of healthy individuals contracting the disease. Institutions are encouraged to select from the suggested methods to safely minimize the amount of inoculum. (Wood-PTT)
W87-05597

LEGIONNAIRES' DISEASE CAUSED BY LEGIONELLA DUMOFFII IN DISTILLED WATER,
Laval Univ., Quebec. Dept. de Microbiologie.
J. R. Joly, P. Dery, L. Gauvreau, L. Cote, and C. Trepanier.
Canadian Medical Association Journal CMAJAX, Vol. 135, No. 11, p 1274-1277, December 1986. 1 tab, 15 ref. Medical Research Council (Canada) Grant MA-7689.

Descriptors: *Distilled water, *Legionnaires' disease, *Water treatment, *Hospitals, *Bacteria, *Water pollution effects, Diseases, Human diseases, Infection, Pathology, Canada, Water use, Water quality.

Five cases of Legionnaires' disease caused by Legionella dumoffii were identified within an 11-month period in a hospital in the Quebec City area. In four cases bacterial isolates were obtained from clinical specimens, and in one case seroconversion was demonstrated. All the patients were admitted to the hospital within 10 days before the diagnosis. Two of the patients were immunosuppressed children. Only 1 of the 40 hot water samples from the hospital yielded L. dumoffii; however, 6 of the 11 distilled water samples contained bacterium. All the patients had been exposed to distilled water, four through respiratory therapy equipment and one through a room humidifier. Following the use of sterile distilled water in the apparatus, no further cases were identified. This is the first reported outbreak of Legionnaires' disease caused by L. dumoffii, and it is the first time that nosocomial legionellosis was been linked to contaminated distilled water in Canada. (Author's abstract)
W87-05598

RELATIONSHIP OF BONE MASS AND FRACTURE HISTORY TO FLUORIDE AND CALCIUM INTAKE: A STUDY OF THREE COMMUNITIES,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Div. of Nutritional Sciences.
M.-F. R. Sowers, R. B. Wallace, and J. H. Lemke.
American Journal of Clinical Nutrition, Vol. 44, No. 6, p 889-898, December 1986. 2 fig, 4 tab, 39 ref.

Descriptors: *Water pollution effects, *Drinking water, *Groundwater, *Fluorides, *Calcium, *Bone mass, *Osteoporosis, Minerals, Potable water.

Stimulated by the suggestion that water fluoride > 1 mg/L may protect against osteoporosis, bone mass of women in three rural communities with differing mineral content of the water was studied. Mean fluoride and calcium of community drinking waters were 4 mg/L and 16 mg/L, respectively, high fluoride community; 1 mg/L and 375 mg/L, respectively, high calcium community; and 1 mg/L and 65 mg/L, respectively, low calcium community. Bone mass was measured by single photon absorptiometry, and women were interviewed about fracture history, dietary intake, and other important covariates. No protective effect was observed with higher fluoride intake. Bone mass was lower in older women from the high fluoride community though not statistically so; these women reported significantly more fractures. There was no observed community difference in young women's bone mass or fracture history. Young women in the high fluoride community consuming calcium and vitamin D in excess of 800 mg/day and 400 IU/day, respectively, had significantly better bone mass ($p < 0.05$) than their peers. (Author's abstract)
W87-05615

BIOLOGICAL METHODS FOR THE RESTORATION OF CONTAMINATED AQUIFERS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W87-05632

ADSORPTION OF ENDOTOXIN MOLECULE IN A MICROPOROUS POLYETHYLENE HOLLOW FIBRE MEMBRANE,
Mitsubishi Rayon Co. Ltd., Nagoya (Japan). Product and Development Center.
Y. Sawada, R. Fujii, I. Igami, A. Kawai, and T. Kamiki.
Journal of Hygiene JOHYAY, Vol. 97, No. 1, p 91-102, August 1986. 5 fig, 2 tab, 27 ref.

Descriptors: *Membrane filtration, *Water treatment, *Filtration, *Endotoxins, *Adsorption, Bacteria, Pyrogens.

The major pyrogenic substance in water is endotoxin (lipopolysaccharide, LPS). Gram-negative bacteria produce individual endotoxin on the cell surfaces and release it into the surrounding medium following cell lysis. The microporous polyethylene hollow fibre (EHF) membrane is capable of adsorbing small-sized (<0.025 micron) lipopolysaccharides. Small-sized LPS had 1/1000 of the endotoxin activity of intact LPS, and may be the short rodlets, rather than long string and spherical forms. The EHF membrane is a unique medium for water purification and has the capacity to adsorb a type of LPS in water by the filtration process. (See also W87-05855) (McFarlane-PTT)
W87-05854

ENDOTOXIN REMOVAL FROM WATER USING MICROPOROUS POLYETHLYLENE CHOPPED FIBRES AS A NEW ADSORBENT,
Mitsubishi Rayon Co. Ltd., Nagoya (Japan). Product and Development Center.
Y. Sawada, R. Fujii, I. Igami, A. Kawai, and T. Kamiki.
Journal of Hygiene JOHYAY, Vol. 97, No. 1, p 103-114, August 1986. 4 fig, 3 tab, 26 ref.

Descriptors: *Adsorption, *Endotoxins, *Water treatment, *Filtration.

A large portion of pyrogens are well-recognized endotoxins (lipopolysaccharides, LPS) which are produced by Gram-negative bacteria. Attempts have been made to remove endotoxins from water by: (a) physical and chemical adsorbents (such as charcoal, ion exchange resin, polyolefine beads, bentonites, immobilized polymyxin B and immobilized histamine); (b) chemical decomposition with alkali; and (c) filtration by ultramembrane filters or reverse osmosis membranes. A new adsorbent, microporous polyethylene chopped fibre was produced from a high density polyethylene. This can adsorb lipopolysaccharides linearly up to 2 h, and showed the highest capacity to absorb LPS when compared to two other polyethylene-based adsorbents and a polystyrene-based adsorbent. Data suggest that the binding of LPS to the new adsorbent is a hydrophobic interaction. The new adsorbent has a greater potential for the removal of endotoxin from tap water than other commercially available adsorbents. (See also W87-05854) (McFarlane-PTT)
W87-05855

INHIBITION STUDY OF THE NITRIFICATION BY ORGANIC COMPOUNDS (ETUDE DE L'INHIBITION DE LA NITRIFICATION PAR LES COMPOSES ORGANIQUES),
Rennes-1 Univ. (France).
H. Benmoussa, G. Martin, F. Tonnard, Y. Richard, and A. Leprince.
Water Research WATRAG, Vol. 20, No. 12, p 1465-1470, December 1986. 5 fig, 1 tab, 8 ref.

Descriptors: *Water treatment, *Nitrificaton, *Organic compounds, *Water pollution effects, *Inhibition, *Aromatic compounds, *Kinetics, Molecular structure, Toxicity, Phenols, Wastewater treatment, Ammonium, Nitrates.

Biological nitrification can be used in water treatment stations in order to eliminate ammonium but this process can be inhibited by the presence of organic compounds. This inhibition by some aromatic compounds (phenols and naphthols) was studied. Both batch and continuous experiments were performed. The observed nitrification kinetics (disappearance of ammonium and appearance of nitrate ions) permitted measurement of the inhibition kinetics and calculation of the inhibition constants K sub i. In the case of phenol, a biodegradable compound with significant toxicity; nitrification activity does not resume until complete removal of the pollutant. For the other compounds one may draw curves for the equation % inhibition = f(concentration). The order of toxicity is phenol > naphthol > 4-chloronaphthol > 2-chloronaphthol > 2,4-dichloronaphthol. The continuous-process experiments permitted comparison of two supports with very different surface properties (expanded clay and activated carbon), and two products as well (methanol, poorly adsorbable, and phenol, easily adsorbable). The results show that a porous support such as activated carbon can effectively protect the nitrifying biomass against a toxic adsorbable substance. MNDO calculations of orbital energies provided values for the LUMO and HOMO of the naphthols. There is a correlation between the energy difference between these two frontier orbitals and the toxicity of the compound. (Airone-PTT)
W87-05902

CHARACTERIZATION OF DISSOLVED ORGANIC MATTER IN SURFACE WATERS THROUGH POLISHING TREATMENT: INFLUENCE OF APPLIED TREATMENTS AND CLIMATE (CARACTERISATION DE LA MATIERE ORGANIQUE DISSOUTE PRESENTE DANS LES EAUX EN COURS D'AFFINAGE: INFLUENCE DES TRAITEMENTS APPLIQUES ET DU CLIMAT),
Institut National Agronomique Paris-Grignon (France). Lab. de Chimie Analytique.
M. Jarret, C. Cavelier, and C. Ducauze.
Water Research WATRAG, Vol. 20, No. 12, p 1477-1488, December 1986. 9 fig, 3 tab, 50 ref.

Descriptors: *Water treatment, *Filtration, *Biological treatment, Activated carbon, *Ozonation, *Dissolved solids, Principal component analysis, Surface water, Mathematical models, Seasonal variation, Drinking water, Oxidation, Statistical analysis.

Little data is available concerning the effect of water purification processes on the molecular weights of organic compounds present in surface water. Fifteen samples of Seine River water, ob-

tained during 4/83-5/84, were studied to determine how activated carbon (AC) filtration modifies the molecular weight distribution of the dissolved organic carbon (DOC) content and to determine as well the effect of various parameters on the efficacy of filtration. The samples, filtered through sand, were ozonized to varying degrees in most (but not all) cases, and then filtered through AC. Ultrafiltration of the resulting waters produced five fractions by nominal molecular weight, which were analyzed (UV, KMnO4 oxidizability). Principal component analysis shows that the quality of the water entering the AC filters depends largely (47% of observed variation) on the level of ozonation and on the temperature. Water filtered through sand and only partly ozonized forms three classes all with MW < 5000, while those strongly ozonized forms two classes with MW < 1000. After AC filtration, water quality depends 19% on temperature, the effects of ozonation being partially damped. This step eliminates 17% of DOC and diminishes UV absorption. The class 1000 < MW < 5000 (easily biodegradable) is hardly affected. Since compounds in this class are important in the resurgence of bacteria in potable water distribution networks, improvement of the biodegradation capability of the filters would best improve their efficacy. Elimination of the fractions 300-1000 and 5000-10000 is temperature dependent and seems biological in nature. An attempt at mathematical modeling of the water leaving the filter in terms of the five MW classes is briefly described. (Airone-PTT)
W87-05904

INTERACTIONS OF HUMIC ACIDS AND ALUMINUM SALTS IN THE FLOCCULATION PROCESS,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
M. R. Jekel.
Water Research WATRAG, Vol. 20, No. 12, p 1535-1542, December 1986. 8 fig, 3 tab, 23 ref.

Descriptors: *Flocculation, *Humic acids, *Aluminum, *Water treatment, Precipitation, Ozonation, Colloids, Dissolved solids, Mathematical equations, Salicylic acid.

The surface complexation of three humic acids on in situ formed aluminum hydroxide at pH=7 was studied by a pH-titration method. The results can be described by a Langmuir equation including the ligand content of humic acids and an affinity constant for the hydroxide surface. About 50% of the acidic functions in humic substances are complexing groups, forming 1:1 compounds. The density of complexing groups increases with the molecular weight. The effects of dilution, neutral salts, and preozonation on complexation equilibria were studied and are discussed. Removal of the organic carbon and aluminum by membrane filtration indicated the formation of soluble or colloidal hydroxo-humate products. Experiments with synthetic organic acids support the assumption that salicylic acid groups are involved in surface complexing. (Author's abstract)
W87-05912

FORMATION EQUATION OF HALOGENATED ORGANIC COMPOUNDS WHEN WATER IS CHLORINATED,
Yokohama National Univ. (Japan). Dept. of Safety and Environmental Engineering.
K. Urano, and T. Takemasa.
Water Research WATRAG, Vol. 20, No. 12, p 1555-1560, December 1986. 13 fig, 1 tab, 11 ref.

Descriptors: *Water treatment, *Chlorination, *Drinking water, *Humic acids, *Water quality standards, Regulations, Mathematical equations, Chlorine, Dissolved solids, Surface water, Chlorinated hydrocarbons.

A variety of halogenated organic compounds is formed by the chlorination of water, principle among them being trihalomethane, the concentration of which in drinking water is now regulated in both the U.S. and Japan. Formation of halogenated organic compounds from a reagent humic acid and extract of a leaf mold were examined under various conditions. The following overall formation equation was obtained from empirical data under the practical wide range in which chlorine was present: (TOX) = (k sub TOX)(TOC)((Cl2) sub 0 to the alpha power)(t to the beta power). Here (TOX) is the concentration of total organic halogen after t h in units of mg of chlorine/l, (TOC) and ((Cl2) sub 0) are concentrations of total organic carbon and dosed chlorine (mg/l), k sub TOX is the rate constant and alpha and beta are parameters. From the values of k sub TOX alpha and beta the character of organic substances (i.e. precursors of halogenated organic compounds) in water can be evaluated. The values k sub TOX, alpha and beta for humic acid are 0.053, 0.28 and 0.13, and the values for extract of the leaf mold are 0.032, 0.36 and 0.15. The activation energies are 10 kJ/mol and 11 kJ/mol for the reactions of humic acid and leaf mold extract respectively. The small size of the activation energies may be because the halogenation reactions are complex and have many pathways. The relation between the equation above (for total halogenated organic compounds) and a similar one for trihalomethane specifically is discussed. (Airone-PTT)
W87-05914

5G. Water Quality Control

SALINITY IN WATERCOURSES AND RESERVOIRS,
Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. Edited by Richard H. French. 622 p.

Descriptors: *Saline water, *Water quality control, *Water pollution, *Water pollution sources, *Rivers, *Reservoirs, Salinity, Management planning, Policy making, Impaired water use, Model studies, Conferences.

This proceeding contains papers presented at a conference, whose purpose was to summarize the state-of-the-art of salinity control in river systems in semi-arid areas, and to further the interchange of information between researchers, managers, designers, and water-users. Chapters within the book cover the following topics: (1) salinity control policy and planning; (2) salinity sources and problems; (3) salinity data base analysis; (4) modeling applied to salinity programs; (5) salinity control problems - agricultural; (6) salinity control programs - nonagricultural; (7) alternative uses of saline water; (8) geochemical and geophysical methods of salinity detection; (9) salinity control project mitigation; and, (10) secondary salinization. (See also W87-05166 thru W87-05218) (Lantz-PTT)
W87-05165

COLORADO RIVER SALINITY - THE USER'S PERSPECTIVE,
Colorado River Board of California, Los Angeles.
M. B. Holburt.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 13-22.

Descriptors: *Colorado River, *Salinity, *Water quality control, Water pollution effects, California, Arizona, Nevada, Cost analysis, River basins, Management planning, Water use.

The entire Colorado River Basin, including the seven states and the Federal government, is vitally concerned with controlling the river's salinity, as it is essential to the use of the river's water in the Lower Basin states and Mexico. The detrimental salinity impacts on users of Colorado River water in the Lower Basin states of California, Arizona and Nevada are both demonstrable and of substantial magnitude. The current cost to Colorado River water users is at least many ten of millions of dollars a year, and will increase significantly unless additional structural and nonstructural salinity control measures are implemented. The seven Colorado River Basin states are continuing their joint efforts to see that salinity control measures are implemented in an expeditious manner so that the Basin states can continue to develop their compact apportioned waters while maintaining the adopted numeric criteria for salinity. (See also W87-05165) (Lantz-PTT)
W87-05166

EVOLUTION OF A COST SHARING POLICY FOR FEDERAL CHLORIDE PROJECTS,
Army Engineer Div. Southwestern, Dallas, TX.
H. G. Robinson, and R. R. DeBruin.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 23-32, 1 fig, 1 tab, 5 ref.

Descriptors: *Cost sharing, *Public policy, *Federal jurisdiction, *Chlorides, Saline water, Cost analysis, Legal aspects, Regulations.

Most Federal Government public works undertakings are guided by cost-sharing legislation that has matured over time. With any new undertaking, several key factors influence the formulation of a cost-sharing proposal acceptable to the U.S. Congress and the Administration: precedent (similarity of project to other proposals with established cost-sharing policy); national objectives at the time; state of the economy; recent laws or policies; and, logic of new cost apportionment proposal. Traced here is the 20-year evoluation of cost-sharing rationale within levels of the Federal Government and involved states on what was a new type of Federal water resource undertaking – control of natural chloride source areas. (See also W87-05165) (Lantz-PTT)
W87-05167

PROBLEM OF SALINITY AND ITS CONTROL, RIVER MURRAY, AUSTRALIA,
River Murray Commission, Canberra (Australia).
T. A. O'Brien.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 33-42, 4 fig, 1 tab.

Descriptors: *Salinity, *Water quality control, *Murray River, *Australia, Water pollution sources, Impaired water use, Irrigation effects, Saline water, Water tables.

The situation in south-eastern Australia, and particularly the River Murray, highlights problems which could be common to rivers which form the border between States or different countries such as the Colorado and the Rio Grande. The salinity problems of the River Murray are real and potentially difficult and the present level of salinity is unacceptable to the users along its lower length. The three primary sources of the salinity are:(a) water diverted from the river and applied to crops; (b) salinization of irrigated land caused by the development of high water tables; and (c) salinization of dry land. While it is a relatively simple matter for the River Murray Commission to state that its policy is 'to contain and reduce', the achievement of this policy may prove more difficult. There is no doubt that the continued viability of the Murray is vital to Australia, and its present problems evoke a highly emotive response which must in the long run ensure a high priority in Government funding so necessary if the existing and emerging problems are to be overcome. (Lantz-PTT)
W87-05168

DRAINAGE AND SALINITY CONTROL PROGRAMS IN PAKISTAN,
International Bank for Reconstruction and Development, Washington, DC.
W. D. Fairchild.
IN: Salinity in Watercourses and Reservoirs. Pro-

ceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 43-52.

Descriptors: *Drainage, *Salinity, *Water quality control, *Pakistan, Cost analysis, Regulations, Management planning, Path of pollutants, Water table, Government supports, Economic aspects, Political aspects, Water supply, Water use.

Water sector programs in Pakistan, and because of the many similarities with the Colorado Basin situation, this discussion may be appropriate to the Colorado River salinity problem. The following has been agreed between the Government and the World Bank: (a) specifications for design and installation shall be consistent with BuRec 'Standard Specifications for Drainage Systems; (b) a major basis on selection of areas to receive subsurface tile would be irrigation suitability land classification; (c) 22 manmonths of expatriate experts qualified similar projects (preparation of plans, designs, and tender documents; modifying and operating subsurface drainage equipment; inspection and operation and maintenance; soils and land classification investigation; monitoring and evaluation); and (d) specifications for subsurface tile construction equipment is comparable to that successfully operating in the Western U.S. There are political as well as economic and financial considerations that the Government must review in selecting areas to be drained. However, it is important to understand that Pakistan has a surplus of high quality land as compared to the available water resources for irrigation. It is estimated that Pakistan has up to 1.6 megahectares underlaid with saline groundwater that fits their 'disaster' classification of having a continuous high water table of less than 1.5 m. The difference between selecting areas that can be drained at a cost averaging $1,800/hectare as compared to areas costing $3,000/ha and upward can be significant when viewed in the context of up to 1.6 megaha that are in urgent need of such drainage. At $1,800/ha, the total investment cost could amount to a staggering $3 billion. Such investment cost will severely tax near and mid-term Pakistani public sector investment programs. (See also W87-05165) (Lantz-PTT)
W87-05169

LEGAL AND INSTITUTIONAL CONSTRAINTS TO SALINITY CONTROL,
Bureau of Reclamation, Provo, UT. Utah Projects Office
J. Franson, and M. Lopez Jr.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 55-61, 6 ref.

Descriptors: *Legal aspects, *Institutional constraints, *Salinity, *Water quality control, Water pollution control, Cost-benefit analysis, Evaporation, State jurisdiction, Political aspects, Water supply, Colorado River, Imperial Dam, Saline water, Water pollution prevention.

The Colorado River at its headwaters in the mountains of north-central Colorado has a salinity concentration of only 50 mg/L. The concentration progressively increases downstream as a result of diversions and salt contributions from various sources and at its peak in 1965 was approximately 925 mg/L at Imperial Dam. Due principally to surplus flows, the salinity concentration at Imperial Dam has been gradually declining and was approximately 750 mg/L in 1980. The recent decreases in salinity concentration are viewed as short-lived and it is estimated that the concentration at Imperial Dam could rise as high as 1,070 mg/L by 1995 without a salinity control program. Approximately three fourths of the salt load and virtually all of the flow in the lower Colorado basin originates in the upper basin. Possible options for slowing down the projected increases of salinity concentration fall into three broad categories: (1) Prevent saline water from entering the Colorado River; (2) Reduce salt pickup of waters entering the Colorado River; and (3) Provide extra water for dilution of salinity. There are legal and institutional constraints which increase the difficulty of implementing many of the proposed salinity control projects. Some of the constraints relate only to one of the categories mentioned above, but others are broader, affecting virtually all salinity control options. Major constraints are: (1) state recognition of evaporation or injection as beneficial use; (2) costs incurred to implement projects; and (3) concern for supplies within each region (city, state, etc). (See also W87-05165) (Lantz-PTT)
W87-05170

USDA PLANNING PROCESS FOR COLORADO RIVER BASIN SALINITY CONTROL,
Soil Conservation Service, Portland, OR.
For primary bibliographic entry see Field 4A.
W87-05171

SALINITY BUBBLES AND OFFSETS: A CONCEPT PAPER,
Environmental Protection Agency, Denver, CO. Water Management Div.
G. R. Reetz.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 79-91, 30 ref.

Descriptors: *Salinity, *Water quality control, *Water pollution control, *Regional planning, State jurisdiction, Colorado River, Saline Water.

Salinity control is technologically and institutionally complex as responsibilities often cut across traditional agency responsibilities. Salinity is the major basinwide quality problem in the Colorado River Basin. The cooperative State/Federal salinity control program in the Colorado River is based on maintenance of 1972 salinity concentrations in the lower mainstem while the Upper Basin develops its compact-apportioned waters. In essence, this approach is a basinwide bubble/offset policy. The bubble and offset concepts offer flexibility in meeting environmental goals and appear particularly appropriate for controlling salinity in the Colorado River Basin. More precisely defining the bubble and offset requirements, within the framework of the current policies, could enhance implementation of salinity control measures, and thereby, insure that the existing numeric salinity criteria are not violated. (See also W87-05165) (Lantz-PTT)
W87-05172

PLANNING AND IMPLEMENTATION FRAMEWORK FOR SALINITY CONTROL IN THE INDUS RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
M. S. Shafique, and G. V. Skogerboe.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 93-102, 3 fig, 1 tab, 5 ref.

Descriptors: *Salinity, *Water quality control, *Indus River, River basins, Rainfall, Irrigation, Drainage, Agriculture, Saline water, Seepage loss, Land management, Saline soils.

About 62% of the Indus Basin lies in Pakistan. The mean annual rainfall varies from 50 to 1000 mm. Approximately two-thirds of the total area receives less than 250 mm of rainfall. The Indus River basin plains start below the Salt Range about 800 miles from the sea. It is a vast land of about 21 million hectares, with very flat topography having an average slope of 0.0002. The total irrigated area in the region is 15 million ha. Drainage is lacking in most of the Indus Basin. Water is being lost by seepage from canals and watercourses and deep percolation from croplands, resulting in high groundwater levels, degradation of downstream water supplies and salt accumulation on the ground surface. One of the important elements in the new strategy for waterlogging and salinity control in the Indus River Basin is attention toward efficient water utilization and its proper management on croplands. Public tubewells having a discharge capacity of 30 to 150 L/s have proven too large because of: (1) drawing upon deeper, more saline, groundwater; and (2) even poorer water management practices. Seepage losses from the farm watercourses improvement programs within the entire basin can reduce these losses by 50% to 90%. Another important salinity-control measure is reducing deep percolation losses from the irrigated lands by providing precision land leveling, conversion to better irrigation methods, irrigation scheduling, etc. In order to make the ongoing water management program in the Indus Basin effective, the role of farmer organizations needs special consideration. The planners are acutely aware of the fact that without such organization the program is likely to fail. Finally, a monitoring and evaluation program is needed for continuous reassessment or 'tuning up' of project implementation. (See also W87-05165) (Lantz-PTT)
W87-05173

SALINITY SOURCES AND PROBLEMS OF THE DANUBE RIVER BASIN,
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W87-05174

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI RIVER,
Army Engineer Div. Southwestern, Dallas, TX.
B. G. Rought.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 115-124, 2 fig, 4 ref.

Descriptors: *Salinity, *Water quality control, Desalination, Water supply, Water conveyance, Hydrostatic pressure, Reservoirs, Saline water, Water pollution sources.

Presented is an overview of the salinity problem in the streams of the Southwestern United States, from the Continental Divide to the Mississippi River. The origin and mechanisms that cause water salinity are reviewed as well as the impacts that the salinity has on the economy and the environment. Various concepts for salinity control (importing fresh water, desalination, pipeline to the Gulf, fresh water diversion, hydrostatic pressure, total impoundment, etc.) for the river basins of the region are discussed including the status of prototype projects currently in place. Future projects representing a permanent solution to the salinity problem are also reviewed. The implementation of these systems require a resolution of institutional problems including payment for construction and for operation of the control systems. The Southwest is a water-short area and all available sources must be considered and eventually utilized. (See also W87-05165) (Lantz-PTT)
W87-05175

ECONOMIC EVALUATION OF SALINITY CONTROL,
Corps of Engineers, Tulsa, OK.
For primary bibliographic entry see Field 6C.
W87-05176

NATURAL SALT POLLUTION CONTROL, BRAZOS RIVER BASIN, TEXAS,
Army Engineer District, Fort Worth, TX.
J. A. McCrory.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 135-144, 6 fig, 3 ref.

Descriptors: *Saline water, *Brazos River, *Texas, *River basins, *Water quality control, Sodium chloride, Calcium sulfate, Gypsum, Dissolved

solids, Project planning, Croton Lake, Dove Lake, Kiowa Peak Lake, Water rights, Water pollution control, Water pollution sources.

The quality of Brazos River main stem water is seriously degraded by emissions from major salt sources in the upper Brazos River Basin. The emissions consist of mineral pollutants composed principally of sodium chloride (common table salt) with moderate amounts of calcium sulfate (gypsum) and other dissolved solids. Because of this natural pollution, the 1,486 km main stem Brazos River from Stonewall County, Texas, to the Gulf of Mexico is of generally poor water quality. In 1963, the US Army Corps of Engineers, Fort Worth District, initiated a basinwide study of the Brazos River Basin. The interim report recommended a three reservoir project with interconnecting pipelines to be located in the salt producing area to control a major portion of the natural pollution. This project, called Plan 4B, consisted of Croton Lake, Dove Lake, and Kiowa Peak Lake. The project, was authorized by Congress in 1976 for Phase I Advance Engineering and Design (AE&D) studies only. These Phase I studies were initiated in 1977, and completed in September 1983. The results of the Phase I AE&D studies were as follows: (1) All of the water of the Brazos River is committed by either contract or water rights. This means that even if the quality of the water was improved, no new municipal, industrial, or agricultural irrigation uses would occur; (2) The present and projected water demands are primarily in the lower basin. This area also happens to be where the water quality is best, due to dilution by good quality tributary water downstream from the source of the pollution. There are less costly alternative sources to Brazos River water in both the Brazos River Basin and adjacent basins. If the water quality were improved and water rights were disregarded, there would be a moderate increase in agricultural irrigation in the upper half of the basin. Minor flood control benefits would accrue to the project because of the total impoundment feature. Minor recreation benefits would accrue to the project. A wildlife habitat mitigation area would provide benefits to offset the land losses caused by the project. Comparison of the total benefits to the total costs of the project, both based on current prices and interest rates, resulted in a benefit-cost ratio of less than 1.0. (See also W87-05165) (Lantz-PTT)
W87-05177

IMPACT OF RESERVOIRS ON SEASONAL AND HISTORICAL SALINITY OF THE COLORADO RIVER,
Bureau of Reclamation, Salt Lake City, UT.
For primary bibliographic entry see Field 5B.
W87-05180

IMPROVING MANAGEMENT PRACTICES ON SURFACE IRRIGATED LANDS: THE ROLE OF MODELING,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
W. R. Walker.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 203-211, 4 fig, 1 tab, 13 ref.

Descriptors: *Water management, *Surface irrigation, *Model studies, Path of pollutants, Water quality control, Irrigation practices, Hydrodynamic models, Zero-inertia models, Kinematic-wave models, Valume balance models, Hydrologic models.

The alternatives for controlling salinity in irrigation return flows must be evaluated on the same scale as they are potentially applicable. This process has involved pilot scale field demonstrations and testing from which detailed data have been collected for use in simulation model verification. Then the models have been employed in simulating the results of other alternatives and combinations of alternatives enroute to defining optimal control strategies. One of the modeling areas where inadequate attention has been paid in most existing models is the distribution of applied water on surface irrigated fields. It has generally been assumed that water is applied uniformly with an application efficiency characteristic of average annual conditions. Both of these assumptions bias the results of an analysis in favor of off-farm salinity control options. A number of major innovations in surface irrigation modeling have been made in the last five years which are now available for the user community. The models (hydrodynamic models, zero-inertia models, kinematic-wave models, and volume balance models) have been evaluated under a wide range of conditions and irrigation practices. Some can be implemented in desk-top computer systems. This paper reviews the state-of-the-art with regard to surface irrigation models and demonstrates some of the most recent advances, with a minimal mathematical treatment. (See also W87-05165) (Lantz-PTT)
W87-05183

SKIMMING WELL MODEL FOR SALINITY CONTROL,
California Univ., Davis. Dept. of Civil Engineering.
B. A. Chandio, and B. E. Larock.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 235-242, 3 fig, 7 ref.

Descriptors: *Skimming wells, *Salinity, *Water quality control, *Model studies, Well water, Withdrawal, Computer models, Hydrologic models, Water table, Computers, Mathematical analysis.

Partially penetrating shallow wells, called skimming wells, are used in some parts of the world to withdraw water for various purposes from a relatively thin band of high quality fresh groundwater which overlies a thicker saline water layer in an unconfined aquifer. As an example, these wells are used for irrigation in the Indus Plain of Pakistan, which contains 12 million hectares of potentially arable land. Such wells must be operated so that the fresh water layer is neither mined nor degraded significantly in quality. Numerous previous studies indicate that the degree of partial well penetration, the thickness of the fresh water layer, the thickness of the water withdrawal zone and the location of the transient water table boundary all affect the successful operation of such wells. Described here is a three-dimensional miscible fluid model of transient unconfined flow toward a skimming well; the role that such a model can play in a salinity control strategy is considered and some preliminary results are presented. This skimming well model appears to model correctly the relevant physical phenomena; its application is most appropriate to relatively thin fresh water layers where mixing can be important. The model is suitable for use on super-mini computers. Owing to the use of linear elements in the model, computations should employ a larger, finer mesh of elements than has been reported here. The modeling of the well itself by one-dimensional elements can easily be adapted to model horizontal collector arms from a radial well and should be investigated further as a salinity control measure. (See also W87-05165) (Lantz-PTT)
W87-05186

SALINITY CONTROL THROUGH WATER CONSERVATION IN THE UPPER COLORADO RIVER BASIN,
Utah State Univ., Logan. Coll. of Engineering.
A. B. Bishop, D. R. Franklin, and R. Narayanan.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 243-252, 2 fig, 1 tab, 3 ref.

Descriptors: *Salinity, *Water conservation, *Colorado River, *River basins, Cost analysis, Cost-benefit analysis, Water use, Water supply.

Considering the problem of increasing salinity in the Colorado River, water conservation offers one alternative for meeting salinity control requirements by decreasing downstream salinity levels through dilution. Agriculture is the predominant water consuming sector in the basin, accounting for 90% of the total depletions. The competition of energy projects for the limited water supply has been evident in the bidding up of the price of water. Resulting increases in the price of water should induce agriculture and other water using sectors in the economy to reduce their consumption. Three salinity control policies are identified in this study. The first is to follow a no-action strategy (case 1). The second is to maintain the EPA established standard of 1972 salinity levels (case 2 and 3). The third is to set salinity levels where downstream marginal benefits are equal to marginal cost of salinity control (case 4 and 5). For the last two policies, solutions with and without government initiated conservation measures are obtained (case 3 and 5). The results of the model indicate that public investments in measures only for the sake of water conservation are not economically efficient since the marginal value of water is less than the cost of conservation. Welfare effects of alternative salinity control policies and the cost-benefit implications toward government sponsored water conservation programs are derived. The analysis indicates that, whether salinity is controlled by EPA established numerical standards, or it is determined by equating marginal benefits and costs, government sponsored water conservation programs could add to the net basin benefits by $2.7 million to $3.9 million by reducing salinity through greater dilution. (See also W87-05165) (Lantz-PTT)
W87-05187

IRRIGATION WITH SALINE GROUNDWATER AS A STRATEGY FOR SALINITY CONTROL IN THE SHEPPARTON REGION OF NORTHERN VICTORIA.
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 3C.
W87-05188

SALINITY CONTROL PROBLEMS ASSOCIATED WITH IRRIGATION IN SOUTH-WEST NEW SOUTH WALES, AUSTRALIA,
Water Resources Commission of New South Wales, Sydney (Australia).
A. Lelij, and S. E. Flint.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 265-274, 2 fig, 1 tab, 3 ref.

Descriptors: *Saline water, *Irrigation effects, *Water quality control, *Water pollution control, *New South Wales, *Australia, Irrigation practices, Saline soils, Groundwater quality, Groundwater level, Effluents, Geomorphology, Case studies, Agriculture.

In common with irrigation in many other semi-arid regions, irrigation schemes on the Riverine Plain of south-west New South Wales have resulted in rises in groundwater levels which have created problems of soil salinization and waterlogging. The raised groundwater levels can also lead to salt intrusion into streams and impairment of water quality if they are not controlled. Subsurface drainage presents problems of disposal of saline drainage effluent without increasing the salinity of water to unacceptable levels for downstream users. The geomorphology of the region and its relationship to groundwater and salinity problems are outlined. Three different case studies of problems and approaches to their solution are presented and discussed. (See also W87-05165) (Author's abstract)
W87-05189

CASE STUDY OF A SALINITY CONTROL PROGRAM, UINTA BASIN, UTAH,
Soil Conservation Service, Salt Lake City, UT.

H. T. Brown.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 275-284, 1 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Water quality control, *Uinta Basin, *Utah, Water use, Irrigation, Irrigation effects, Water pollution sources, Water pollution prevention, Saline water, Colorado River, Imperial Dam, Cost analysis, Cost-benefit analysis, Irrigation practices, Agriculture.

The Uinta Basin Unit Salinity Control Project was initiated in 1980 under Title II of the Colorado River Basin Salinity Control Act. All work was implemented on private land. The Ute Indian Tribal Council, in a letter dated April 28, 1978, authorized the inclusion of Indian lands. The Uinta Basin is in northeastern Utah and covers parts of Duchesne, Uinta, and Wasatch Counties. The area has two major drainages, Ashley Cree-Brush Creek and Duchesne River. These drainages and their tributaries provide all the water used for irrigation. About 50,000 ha of irrigated land were treated under the salinity control program. It is estimated that 69,475 metric tons of salt-loading from the irrigated area can be eliminated from the Colorado River system annually. This translates to 10.3 mg/L at Imperial Dam. Based on downstream losses of $513,300 per mg/L (January 1982), annual benefits are $5,286,990. On-site benefits will increase because of lower operating costs and higher crop yields. These factors will be determined by the monitoring and evaluation team. The experience gained in the Uinta Basin will provide valuable data and methodology for future on-farm salinity control projects. The ability of all units of government, agencies, and groups to cope with organizational and coordination problems has been outstanding. This project reemphasizes the ability of people to work together for a common cause. (See also W87-05165) (Lantz-PTT)
W87-05190

CASE STUDY OF A MAJOR AGRICULTURAL CONTROL PROGRAM - THE GRAND VALLEY EXPERIENCE,

Soil Conservation Service, Denver, CO.
M. E. Hess.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 285-294, 3 tab, 7 ref.

Descriptors: *Case studies, *Irrigation practices, *Grand Valley, *Colorado, *Colorado River, *Water quality, *Salinity, Saline water, Imperial Dam, Irrigation ditches, Monitoring, Water pollution sources, Water pollution prevention.

Historically, salinity concentration in the Colorado River below Imperial Dam has averaged about 768 mg/L. In 1961, the concentration increased to nearly 1,400 mg/L and to more than 1,500 mg/L in 1962. Among other things in the Colorado River Basin Salinity Control Act, the United States agreed to adopt measures to assure that water delivered to Mexico would have a salinity concentration of no more than 115 mg/L over the average quality of water arriving at Imperial Dam. From 1973 to 1979, the average quality of water arriving at Imperial Dam decreased from 846 mg/L to 809 mg/L probably due in part to the construction of upstream storage reservoirs on the Colorado River. However, irrigating with water having salinity concentrations at this level can reduce agricultural yields to about 80% of maximum potential yields. Studies indicate that the Grand Valley annually contributed about 526,000 tons (metric of salt to the Colorado River. A study by the Soil Conservation Service shows that 270,000 tons is attributed to onfarm irrigation. It is estimated that onfarm improvements might effectively reduce the annual load by 120,000 tons. The onfarm program for salinity control has three components. These are: (1) Installing structural measures to reduce seepage from unlined earthen irrigation ditches; (2) Improving irrigation water management practices to reduce deep percolation from field irrigation and to enhance uniformity of irrigation applications; and (3) Implementing a monitoring and evaluation program to assess the effectiveness of installed salinity control measures. Key elements of the program are to measure surface inflow and runoff to determine the amount of water infiltrating into the Ground. These data will be used to compute salt loading under improved management practices and will help identify further improvements needed in management practices to achieve objectives of the salinity control program. Salt loading evaluated under improved management will be compared with loading evaluated during planning to show effectiveness of the program. (See also W87-05165) (Lantz-PTT)
W87-05191

GRAND VALLEY STAGE ONE MONITORING PLAN AND IMPLEMENTATION,

Bureau of Reclamation, Grand Junction, CO.
D. L. King.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 295-304, 3 fig, 2 tab, 3 ref.

Descriptors: *Water quality control, *Performance evaluation, *Monitoring, *Salinity, *Grand Valley, *Colorado, Groundwater pollution, Saline water, Water pollution sources, Fate of pollutants, Water pollution prevention, Quantitative analysis, Canals, Reed Wash.

The Grand Valley Unit in western Colorado is a component of the Colorado River Basin Salinity Control Project and was authorized for construction by the Colorado River Basin Salinity Control Act of 1974 (Public Law 93-320). The purpose of the Grand Valley Unit is to reduce the salt loading to the Colorado River attributable to agricultural practices by improving the water delivery system and installing on-farm improvements. To assess the effectiveness of Stage One improvements on groundwater flows and salt loading, a hydrologically-closed basin, known as the Reed Wash study area, has been equipped to monitor surface and groundwater inflows, outflows, and levels. A monitoring program was implemented to establish preconstruction hydrologic conditions and to observe the effects of canal lining and lateral piping on salt loading in the watershed. The monitoring program indicates that the water system's improvement has been effective in reducing seepage and salt loading from canals and laterals. The Reed Wash area will be monitored for a number of years to verify the effectiveness of the lining program. The year 1983 was the first year with the entire program installed. The results of the monitoring program could influence the predicted effectiveness of other salinity control projects. (See also W87-05165) (Lantz-PTT)
W87-05192

MEASURES FOR REDUCING RETURN FLOWS FROM THE WELLTON-MOHAWK IRRIGATION AND DRAINAGE DISTRICT,

Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
R. J. Effertz, W. K. Sidebottom, and M. D. Turley.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 305-314, 1 tab.

Descriptors: *Water quality control, *Water Management and Conservation Program, *On-farm Improvement Program, *Colorado River, *Salinity, Performance evaluation, Water resources, Water management, Irrigation, Saline water, Percolation.

The Gila Project was reauthorized in 1947 to include an irrigation system to deliver Colorado River water to 30 250 ha (75,000 acre) in the Wellton-Mohawk area. The first project water was delivered to the area in 1952 and the project was completed in 1957. This solved the water supply problem by giving the District a dependable supply of better quality irrigation water. Leaching and other land reclamation practices greatly improved the land productivity. However, the plentiful supply of Colorado River water caused the groundwater table to rise and created a serious drainage situation. Although it is very difficult to isolate the effects of individual measures of the irrigation efficiency improvement program, the first and most dramatic results were realized from the removal of approximately 2,500 ha (6,200 acres) of irrigated land from the District. The next most effective measures are the On-farm Improvement Program and the Water Management and Conservation (WMC) Program. Precise, laser controlled leveling of fields that are designed to accomodate soil conditions, along with larger heads of water delivered through concrete lined farm laterals and turnouts, has been highly effective in reducing water use rates and deep percolation. Treatment on a total of 17,300 ha (42,800 acres) is expected to be accomplished by 1986 with the possible effects of reducing on-farm deep percolation below 123,500 cu dam/yr (100,000 acre-feet/yr). The WMC Program enables the irrigator to get optimum results in production with a minimum amount of water and to get the best use of efficiently designed farm units. Up to 14,200 ha (35,000 acres) of land, both onfarm treated and other efficient units, have utilized the WMC Program. This program has spread to about 6,100 ha (15,000 acres) in other districts of the lower Colorado River water service area. (See also W87-05165) (Lantz-PTT)
W87-05193

SALINITY CONTROL AND DRAINAGE IN NORTHERN VICTORIA (AUSTRALIA),

Victoria State Rivers and Water Supply Commission, Armadale (Australia).
K. O. Collett, and G. C. Earl.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 315-323, 1 fig.

Descriptors: *Salinity, *Water quality control, *Victoria, *Australia, *River Murray, Irrigation practices, Irrigation effects, Groundwater irrigation, Water reuse, Saline water.

Broadly covered here is the salinity and drainage strategy in the northern part of the State of Victoria, Australia. Since 1975, a salinity strategy of maintaining the viability of established irrigation, while protecting River Murray quality, has been promoted. Work has progressed on a number of fronts, including the implementation of schemes to intercept and dispose of salt inputs to the River Murray, such as at Mildura-Merbein in the Sunraysia Region. In 1974/75 the Commission commenced a program (Phase A) of installation of groundwater pumps for the protection of orchards, and is concluding it this year. About 50% of the 2,000 microsiemens per cm (msm/cm) groundwater extracted by the 80 pumps in the program is disposed of by dilution in the supply channel system to 500 msm/cm or less, followed by re-use. The remainder outfalls to the River Murray via channel outfall points in the winter non-irrigation season, or via drains. The resultant River Murray salinity increment is small - less than 5 msm/cm - in the downstream State of South Australia. An additional strategy stage, Phase B, in which 435 Commission owned and operated groundwater pumps would provide protection to 125,000 ha of the more intensively developed pasture properties. About 60% of the extracted groundwater was to be re-used after dilution to 500 msm/cm in the channel system, and the remainder was to be outfalled to the River Murray. It was recognized that the resulting 75 msm/cm increment in River Murray salinity just downstream of the Shepparton Region could be significant for downstream water users. Two of the on-farm measures are discussed here: landforming and on-farm recycling. On-farm recycling is not being implemented by many farmers because of the high cost of the recycled tail-

water compared with channel supplied water. (See also W87-05165) (Lantz-PTT)
W87-05194

CONTROLLING SALINITY IN THE COLORADO RIVER BASIN, THE ARID WEST,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
A. R. Jonez.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 337-347, 3 fig, 5 ref.

Descriptors: *Salinity, *Water quality control, *Colorado River Basin, *Arid regions, *Water pollution sources, Mineral salts, Saline water, Economic aspects, Cost analysis, Irrigation practices, Agriculture, Water management.

The Colorado River is the lifeline for more than 17 million people in seven arid States and Mexico. The river, while nearly pure at its origins in the snowcapped Rocky Mountains, carries about 8 million megagrams (9 million tons) of mineral salts annually past Hoover Dam. The salt pollution damages irrigated crops, causes accelerated plumbing replacement and appliance wear, and causes annual damages of over $120 million. Projections are that without any controls, annual damages of over $238 million will occur by about 2010. Average annual economic losses of $120 million from increasing salinity in the Lower Basin of the Colorado are impressive. Salt pollution affects more than 10 million people and 405,000 ha or irrigated farmland in the United States. About 70% of the economic losses are associated with municipal and industrial use and occur when salinity concentration levels are above 500 mg/L. For irrigators, the higher concentrations cause decreased crop yields, altered cropping patterns, higher leaching and drainage requirements, and higher management costs. Economic losses to agriculture (either through lower yields or higher production/management costs) usually begins when salinity levels of applied irrigation water reach 700 to 850 mg/L, depending upon soil conditions and type of crop grown. Alternative ways of solving the salinity problem depend partly upon the way the salt enters the river. More than a third of the salt enters the river from irrigation sources. Some of these are: irrigation source model, point source control, and diffuse source control. In order to minimize risk, staging or incremental implementation of project features is being used on several units. Staging allows additional time to monitor actual results and minimize investment if certain features are not proved effective. (See also W87-05165) (Lantz-PTT)
W87-05196

SALINITY CONTROL BY PUMPING AND DEEP WELL INJECTION - THE PARADOX VALLEY UNIT,
Bureau of Reclamation, Durango, CO.
E. G. Jensen, and by R. W. Leach.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 349-358, 6 fig.

Descriptors: *Salinity, *Water quality control, *Pumping, *Deep well injection, *Paradox Valley, *Colorado, Saline water, Imperial Dam, Colorado River, Water pollution sources, Water pollution control, Salt, Cost analysis.

The Paradox Valley Unit has the potential to reduce the salinity content of the Colorado River at Imperial Dam by 18.2 mg/L or 1.63 E+08 kg (180,00 tons) of salt per year, with only 1.79 E+06 cu m (1,448 acre-ft) or river water depletion. Studies have determined that an annual benefit of $540,000 (1983 prices) can be realized by a reduction of 1 mg/L as salinity concentration in the Colorado River approach 1,000 mg/L. The project is feasible, and when completed will benefit the Colorado River system. Deep-well injection as a method of disposal will reduce the original plan's project costs by one-half to one-third, a savings of about $60,000,000 to the American taxpayers. Drilling and testing of the first test disposal well is scheduled for early 1984. (See also W87-05165) (Lantz-PTT)
W87-05197

SALINITY CONTROL BENEFITS THROUGH REGULATION OF PRODUCED WATER,
Utah Bureau of Water Pollution Control, Salt Lake City.
For primary bibliographic entry see Field 5E.
W87-05199

ARKANSAS-RED RIVER BASINS CHLORIDE CONTROL PROJECT: TECHNICAL FEASIBILITY STUDIES FOR PLAN OF CONTROL,
Corps of Engineers, Tulsa, OK.
For primary bibliographic entry see Field 5E.
W87-05200

GLENWOOD-DOTSERO SPRINGS SALINITY CONTROL PROJECT,
URS Co., Denver, CO.
C. A. Macko.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 389-396, 1 fig, 1 tab.

Descriptors: *Glenwood Springs, *Dotsero Springs, *Colorado River, *Salinity, *Water quality control, *Management planning, Groundwater, Water pollution sources, Geohydrology, Cost analysis, Computer models, Water quality, Aquifers.

Glenwood Springs and Dotsero are located along a 25.8-km stretch of the Colorado River. West of Dotsero, at the upstream end of Glenwood Canyon, eleven measured springs plus subsurface inflows contributed an estimated 1.18 times 10 to the 8th kg/yr of salt to the Colorado River. At Glenwood Springs, a total of twelve surface springs are measured. Four of these are used commercially. The total salt contribution from the Glenwood Springs area is estimated at 2.80 times 10 to the 8th kg/yr. Field investigations were conducted: (1) to delineate the saline groundwater systems at Dotsero and Glenwood Springs; (2) to determine the subsurface collection capabilities at both locations; (3) to determine if the selected site was geotechnically suitable for evaporation ponds; and (4) to determine the permeability and other properties of materials to be used as compacted earth liner materials. While the field investigations which began in June 1982 addressed all of the objectives, only the first two are discussed in detail in this paper. The results of the field investigations were used in the designs and cost estimates for the components of the recommended plan. Analysis of the Dotsero aquifer test data indicated that a well field could collect approximately 0.20 cu m/s of saline water from the subsurface without dilution from the Colorado River. The well field would probably result in reduced flow from several of the surface springs in the upstream reach of the hot springs area. At Glenwood Springs, a computer model was calibrated with the aquifer test data and extensive modeling efforts were undertaken to design a well field which would not impact the commercial users. The result was a field designed to collect 0.014 cu m/s from the subsurface with surface collection accounting for the remaining water. Although 0.014 cu m/s is a small quantity of water, the high TDS concentration makes its collection cost effective. Total collection at Dotsero is projected to be 0.20 cu m/s from a well field and 0.14 cu m/s from surface springs. At Glenwood Springs, surface spring collection is estimated at 0.26 cu m/s with 0.014 cu m/s from wells. Total saline water collection is projected at 0.61 cu m/s. (See also W87-05165) (Lantz-PTT)
W87-05201

SALINITY CONTROL ON THE SMOKY HILL RIVER IN CENTRAL KANSAS,
Kansas State Geological Survey, Lawrence.
C. D. McElwee, M. Butt, A. Fleming, and A. Severini.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 397-406, 7 fig, 2 tab, 5 ref.

Descriptors: *Water quality control, *Smoky Hill River, *Kansas, *Saline water, Relief wells, Aquifers, Groundwater, Mathematical models, Model studies, Leakage, Discharge flow, Salinity, Water pollution control.

Between Salina and Enterprise, Kansas, the Smoky Hill River picks up a considerable amount of saline water. The source of the saline water is predominantly from groundwater dissolution of the Hutchinson Salt Member of the Wellington Formation of Permian Age. One method of alleviation that has been considered is a system of relief wells in the Wellington aquifer just north-east of Salina, Kansas. Modeling methods are applied to evaluate the effectiveness of various systems. The volume reductions of salt-water leakage are in the 20% range. Regional flow can capture about 50% of the freshwater leakage induced by the relief wells in some cases. The result is that the water discharged in the natural discharge zone is considerably diluted. The best net effect of the relief-well systems modeled may be a reduction of 77-85% in the salt load discharged to the alluvium. However, it is estimated that 40-160 years may elapse before most of the dilution effect is felt at the discharge area. (See also W87-05165) (Lantz-PTT)
W87-05202

PRICE/SAN RAFAEL RIVER BASINS SALINITY INVESTIGATION,
CH2M/Hill, Boise, ID.
B. A. Johnson, and J. A. Riley.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 407-416, 1 fig, 3 ref.

Descriptors: *Price River, *San Rafael River, *Saline water, *Water quality control, Planning, Salinity, Agriculture, Cost analysis, Irrigation practices, Water collection, Water use, Groundwater.

The Price and San Rafael River Basins, with drainage areas of approximately 4,900 and 4,400 sq km, respectively, are located in east-central Utah. Both rivers originate in the mountainous Wasatch Plateau and flow southeast to the Green River, a tributary to the Colorado. Historical records show that the average annual salt contribution to the Colorado River System is approximately 3.94 x 108 kg/yr form the two river basins. Although much of this salt is attributable to natural processes, historical evidence indicates that agricultural practices are responsible for the greatest contribution. The salinity investigation consisted of analysis of existing data, development of hypotheses concerning salt loading mechanisms and possible solutions, collection of field data to verify quantities and sources of salinity, and formulation and analysis of viable alternatives. The most cost effective options include a combined plan for on-farm irrigation improvements and winter water system improvements; collecting and using drainwater for cooling using BCT technology; and collecting and using the drainwater to develop tar sands. It is likely that any selected plan will include a combination of all three of these, plus perhaps some retirement of farmland to provide industry with additional freshwater needed to make up the deficit of available drainwaters. Additional research is needed to confirm yields from the irrigation drains, to demonstrate the use of saline water in binary cooling towers, to refine the use of saline waters in tar sands development, to develop a mitigation plant, to refine on-farm efficiencies, and to understand groundwater interactions. (See also W87-05165) (Lantz-PTT)

W87-05203

LIVING WITH SALINITY: AN EVALUATION OF TWO POLICY MEASURES WITHIN A REGIONAL FRAMEWORK,
Hebrew Univ. of Jerusalem (Israel). Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W87-05206

REUSING SALINE DRAINAGE WATERS FOR IRRIGATION: A STRATEGY TO REDUCE SALT LOADING OF RIVERS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3C.
W87-05207

IRRIGATION AS A SOLUTION TO SALINITY PROBLEMS OF RIVER SYSTEMS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 3C.
W87-05208

AQUATRAIN PIPELINE SYSTEM,
Bureau of Reclamation, Denver, CO. Office of Saline Water Transport and Use.
M. J. Clinton, and I. E. McKeever.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 483-492, 1 fig.

Descriptors: *AQUATRAIN, *Water quality control, *Salinity, *Pipelines, *Colorado River, *Project planning, Saline water, Wyoming, Colorado, Utah, Regional planning.

The AQUATRAIN Project -- a unique, innovative concept with multiple goals and benefits -- is a joint venture of the Federal Government and private industry, working cooperatively with the seven Colorado River Basin States. The foremost reason for Federal and State participation is to reduce salinity in the Colorado River at the lowest cost and, where possible, to use the saline water beneficially. The prime goal of private industry is to achieve an economically competitive, long-term method of transporting coal and other commodities from Wyoming, Colorado, and Utah to domestic markets in the southwest U.S. and possibly export markets. New opportunities for pipeline use are emerging as AQUATRAIN progresses, and technology development is continuing. Project support is widespread and growing rapidly. The Basin States, through the Colorado River Basin Salinity Control Forum, have indicated their support by participating in addressing State issues. Regional and local support is anticipated and, on a national level, early discussions with commodity producers, transportation companies, utilities, and port facility developers have been positive. Studies to be done in the planning stage, scheduled for mid-1983 to mid-1985, will be used to determine the feasibility of the system. (See also W87-05165) (Lantz-PTT)
W87-05210

FISH AND WILDLIFE MITIGATION PROGRAM FOR THE COLORADO RIVER BASIN SALINITY CONTROL PROJECT - A CASE HISTORY,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 6G.
W87-05215

TRIANGLE CONSERVATION DISTRICT - A CASE STUDY IN DRYLAND SALINE SEEP CONTROL,
Triangle Conservation District, Conrad, MT.
T. Dodge, J. Holzer, W. Adams, J. Farkell, and M. R. Miller.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 561-570, 2 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Water quality control, *Saline seeps, *Montana, *Triangle Conservation Area, Saline soils, Water pollution sources, Groundwater pollution, Groundwater quality, Irrigation, Agriculture, Management planning.

Saline seeps are recently developed saline soils in non-irrigated areas that are wet some or all of the time. The soils often have white salt crusts on the surface that inhibit or prevent crop or grass production. This resource problem, and proposed solutions in a nine-county area in north-central Montana called the Triangle Area, are discussed. In 1978, the Montana Bureau of Mines estimated that there were 81,000 ha of non-irrigated cropland affected by saline seep in the state and seeps were growing at 10% a year. More recent estimates suggest that the figure may be low. The estimated acreage of saline seep in the Triangle Area in 1981 was 40,000 ha. Besides limiting or eliminating crop production, saline seeps have been recognized by the Montana Department of Health and Environmental Sciences as posing the greatest threat to the contamination of the shallow groundwater resource in the State of Montana. Farm-by-farm assistance for saline seep control is the quickest and best way to solve the problem. Developing a successful saline seep plan requires a commbination of the 'ideal' solution and pratical considerations--economics, land ownership, farm program participation, type of farm operation, etc. Effective saline seep control frequently alters the entire farm operation. The changes in management require technical assistance throughout the implementation stage by a team of agronomic and soils specialists. (See also W87-05165) (Lantz-PTT)
W87-05217

ISSUES IN GROUNDWATER MANAGEMENT.
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 4B.
W87-05219

GROUNDWATER--THE CHANGING PROBLEM IN TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 4B.
W87-05220

EPA'S GROUNDWATER PROTECTION STRATEGY,
Environmental Protection Agency, Dallas, TX. Region VI.
E. P. Allen.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 489-495, 4 ref.

Descriptors: *Groundwater pollution, *Standards, Environmental Protection Agency, Water quality control, Groundwater management, Groundwater quality.

The EPA Ground-Water Protection Strategy (GWPS) provides a method for EPA to coordinate groundwater protecion efforts under its various programs and to assist states in groundwater programs development. The states have the fundamental responsibility for the protection and management of groundwater. EPA, on the other hand, has the responsibility for regulating specific contaminants and sources of contamination. This EPA GWPS does not address groundwater quantity and allocation, as these are outside the province of EPA. The GWPS guidelines are intended to provide a framework for the decisions that EPA and the states will make in implementing EPA programs. As such, beyond complying with the statutory and regulatory responsibilities under EPA programs, each state's participation in planning and achieving the GWPS goals is voluntary. (See also W87-05219) (Lantz-PTT)
W87-05249

FUNDAMENTAL RESEARCH ON ESTUARIES: THE IMPORTANCE OF AN INTERDISCIPLINARY APPROACH.
National Research Council, Washington, DC. Commission on Physical Sciences Mathematics and Resources.
For primary bibliographic entry see Field 2L.
W87-05253

SEWAGE SLUDGE AS AN ACIDITY FILTER FOR GROUNDWATER-FED LAKES,
Freshwater Biological Association, Ambleside (England).
W. Davison.
Nature NATUAS, Vol. 322, No. 6082, p 820-822, August 1986. 3 fig, 8 ref.

Descriptors: *Water quality, *Acid rain, *Water pollution treatment, *Acidic water, *Sludge utilization, *Groundwater, *Lake restoration, Lime, Filtration, Hydrogen ion concentration, Sulfates, Lake sediments, Neutralization, Lake beds.

The use of a combined treatment of lime and sewage sludge, which produced a self-regulating system, capable of maintaining a stable pH was tested in a pilot reclamation program for an acidified lake. Activated sewage sludge was pumped into the lake through a pipeline and calcium hydrated lime was added through a submerged pipe to the deepest point. Within days, the sewage sludge settled out to leave clear water. The pH quickly rose with the addition of lime, after which the solubility of calcium carbonate became the controlling factor and pH stabilized. Four sediment cores were analyzed which showed that appreciable quantities of sulfate had been reduced. Liming and the nutrients associated with sludge stimulated high biological productivity and enhanced the sediment's capacity for sulfate reduction. This scheme of permanent neutralization will be most effective when applied to large lakes with flat bottoms and deep water. By artificially introducing eutrophication, sufficient base can be produced to also neutralize acidification from atmospheric sources. (Michael-PTT)
W87-05259

DECENTRALIZATION OF RISK MANAGEMENT: THE CASE OF DRINKING WATER,
Abt Associates, Inc., Cambridge, MA.
D. Berry, and J. A. Stoeckle.
Journal of Environmental Management JEVMAW, Vol. 22, p 373-388, June 1986. 2 tab, 19 ref.

Descriptors: *Risks, *Drinking water, *Local governments, *Public Michigan, Vermont, Contamination, Organic compounds, Health effects, Education, Public rights.

Risk management activities may be undertaken at the local (decentralized) level or at the federal (centralized) level. Educational and institutional factors affecting the workability, outcomes and ability to protect democratic values of a decentralized approach were examined in case studies. Five communities in Massachusetts, Michigan and Vermont were studied with regard to local actions dealing with contamination of drinking water by volatile organic compounds. Educational processes varied from informative programs to adversarial stands on health effects and contaminant occurrence. In some communities, existing institutions were able to manage health risks efficiently, but in other controversy generated development of new institutions for risk management, citizen advisory committees or citizen action groups. It is concluded that decentralized risk management will probably work best when the occurrence of risk is localized, when local institutions are perceived as capable and when people comprehend the risk situation and risk management options. (Author's abstract)
W87-05273

HISTORIC RELATIONSHIP OF WATER QUANTITY AND WATER QUALITY,
Vranesh and Raisch, Boulder, CO.
For primary bibliographic entry see Field 6E.
W87-05286

EPA VERSUS COLORADO: NATIONAL UNITY VERSUS STATE FLEXIBILITY,
For primary bibliographic entry see Field 6E.
W87-05293

PRIVATE ENFORCEMENT OF THE CLEAN WATER ACT,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.
W87-05294

SPRAY IRRIGATION CHALLENGED IN VERMONT,
For primary bibliographic entry see Field 5D.
W87-05303

SOLID WASTE MANAGEMENT: SELECTED TOPICS.
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5E.
W87-05326

DISPOSAL ON LAND (MODEL CODE OF PRACTICE),
Greater London Council (England). Dept. of Public Health Engineering.
For primary bibliographic entry see Field 5E.
W87-05327

TRAINING OF SANITARY ENGINEERS IN EUROPE.
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
World Health Organization, Geneva, Switzerland, 1985. Edited by Robert B. Dean. 198 p.

Descriptors: *Training, *Sanitary engineering, *Europe, *United States, *World Health Organization, Public health, Education, International commissions, Surveys, Civil Engineering.

The report on a Consultation on the public health component of sanitary engineers' training curricula, held in Copenhagen from November 8 to 10, 1982 is presented to assess the availability of sanitary engineers in Member States of the European Region of the World Health Organization (WHO). As a result of this meeting, a directory of institutions offering training in sanitary engineering was prepared, containing 33 short reviews consisting of each training program's curriculum. Fifteen programs from countries of the WHO European Region and three programs of United States institutions are described in more detail. An historical survey of the development of sanitary engineering and the training and tasks of sanitary engineers forms part of the report on the Consultation. Undergraduate training of sanitary engineers usually takes place in a school of civil engineering while postgraduate training takes many forms, ranging from a 1-yr university program to a series of special short courses in a continuing special education program sponsored by a professional association. To be effective, a training program must conform with the basic educational and legislative principles of the country concerned. (Geiger-PTT)
W87-05331

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 1, RECOMMENDATIONS.
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 5F.
W87-05332

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 2, HEALTH CRITERIA AND OTHER SUPPORTING INFORMATION.
World Health Organization, Geneva (Switzerland).
World Health Organization, Geneva, Switzerland, 1984. 335 p.

Descriptors: *Water quality standards, *Drinking water, *Toxicity, *Public health, *Water pollution effects, Viruses, Bacteria, Protozoa, Disinfection, Bioindicators, Water quality control, Radioactive wastes, Toxins, Organic compounds, Taste, Odor, Inorganic compounds.

The health criteria used to select water pollutants for which guidelines were recommended in Volume 1 are outlined. In addition, information is provided regarding the detection of contaminants in water and measures for their control. A review of the toxicological, epidemiological and clinical evidence used in deriving the recommended guideline values is also included. In Part 1, the bacteriological and virological qualities of drinking water are examined. In Part 2, protozoa, helminths, and other free-living organisms are discussed. Sixteen health-related inorganic constituents (As, asbestos, Ba, Be, Cd, Cr, cyanide, fluoride, hardness, Pb, Hg, Ni, nitrate, nitrite, Se, Ag, and Na) are examined in Part 3. In Part 4, several health-related organic constituents (chlorinated alkanes, chlorinated ethenes, polynuclear aromatic hydrocarbons, pesticides, chlorobenzenes, benzene and lower alkyl benzenes, phenol and chlorophenols, and trihalomethanes) are discussed. In Part 5, factors affecting the aesthetic and organoleptic properties of drinking water are presented. Basic considerations for radioactive materials, sources of radiaion exposure, guideline values for gross alpha and gross beta activity, and radon in potable groundwater sources are discussed in Part 6. (See also W87-05332 and W87-05334) (Geiger-PTT)
W87-05333

GUIDELINES FOR DRINKING-WATER QUALITY: VOL. 3, DRINKING-WATER QUALITY CONTROL IN SMALL-COMMUNITY SUPPLIES.
World Health Organization, Geneva (Switzerland).
World Health Organization, Geneva, Switzerland, 1985. 121 p.

Descriptors: *Water quality standards, *Drinking water, *Sampling, *Pollutant identification, *Rural areas, Water pollution prevention, Sanitation, Public health, Water supply, Bacteria, Water quality control, Residual chlorine, Coliforms, Microbiological studies, Chemical analysis.

Water quality guidelines are suggested for drinking water supplies in small communities, particularly those in rural areas. The microbiological quality of such supplies is emphasized. Information is given on sanitary inspections, the collection of water samples, simple methods for bacteriological analysis, and methods for determining residual chlorine, suitable for rural areas. The remedial and preventive measures that are needed to maintain water quality and the community participation which is required to combat waterborne diseases are discussed. Included in appendices to the report are data on contributors and reviewers, and information on sanitary inspections, collection of water samples for microbiological examination, field tests for bacteriological analysis, the multiple tube method for bacterial counts, the membrane-filter method for coliform counts, and three techniques for the determination of residual free chlorine. (See also W87-05332 and W87-05333) (Geiger-PTT)
W87-05334

EPA HANDBOOK FOR IMPROVING POTW PERFORMANCE.
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-05336

SCHISTOSOMIASIS: A MAJOR WORLD SCOURGE WITH FEW SIGNS OF HOPE,
Hospital for Tropical Diseases, London (England). Dept. of Clinical Tropical Medicine.
G. C. Cook.
Annals of Saudi Medicine, Vol. 6, No. 4, p 237-241, October 1986. 25 ref.

Descriptors: *Water quality, *Water pollution effects, *Water pollution control, *Schistosomiasis, *Public health, *Human diseases, *Epidemiology, Diseases, Parasites, Snails, Mollusks, Biocontrol, Pesticides, Developing countries.

The diagnosis, epidemiology, control, and treatment of schistosomiasis are discussed. Schistosomiasis affects an estimated 200 million people in 74 developing countries. Although this scourge has been affecting man for many thousands of years, the disease is still spreading and becoming even more of a problem, endangering almost 600 million potential victims around the world. Schistosomiasis is widespread in Saudi Arabia and the Middle East and with the risk of further spread, it requires the concerted efforts of both the curative and preventive wisdom of the medical community. (Author's abstract)
W87-05344

USE OF CUMULATIVE SUM ANALYSIS TO ASSESS POLICY IMPACTS ON THE RIVER EBBW, WALES,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
P. Wathern, S. N. Young, I. W. Brown, and D. A. Roberts.
Journal of Environmental Management JEVMAW, Vol. 23, No. 2, p 139-148, September 1986. 7 fig, 11 ref.

Descriptors: *Wales, *Policy making, *Data interpretation, *Water quality, *Water quality management, *Mathematical analysis, *Rivers, Decision making, Political constraints, Wastewater, Industrial wastewater, Water pollution sources, Water pollution, Ammonia, Nitrogen, Environmental policy, Statistical analysis, Effluents.

Water quality data for the River Ebbw (Wales) over the period 1967-82 is analyzed using the cumulative sum technique. Water quality at Cwm with respect to four-hour permanganate values was dictated by discharges from one large industrial plant. Cumulative sum analysis showed that significant changes in water quality were related to waste treatment facilities at the plant, installed in response to policies designed to improve water quality. Cause-effect relations for the NH3-N content of water could not be established with certainty. Decreases in NH3-N content of river water could not be ascribed to one specific cause and were probably related to a number of factors. It is concluded that the cumulative sum technique can be used to quantify the effects of any observed change in water quality. However, when consecutive points of change represent a mixture of improvements associated with a policy and deterioration associated with another cause, it becomes difficult to determine the contribution of any individual factor. Therefore, it is probably of greater value in identifying points of change than in quantifying those changes. (Author's abstract)
W87-05345

TOWARDS AN INTEGRATED APPROACH TO POLLUTION CONTROL: THE BEST PRACTICABLE EVNIRONMENTAL OPTIONS AND ITS ANTECEDENTS,
Durham Univ. (England).
L. D. Guruswamy, and S. R. Tromans.
Journal of Planning and Environment Law, p 643-655, September 1986. 54 ref.

Descriptors: *Water law, *Legal aspects, *Water pollution control, *Planning, *Administration, *Law enforcement, *Public policy, *Environmental policy, Legislation, Policy making, Water pollution effects, Standards, Judicial decisions, Protection, Environmental protection, Environmental quality.

The laws dealing with planning and control of pollution in England are characterized by a pragmatic approach that tends to fragment the environ-

ment into separate media. This seems to display little understanding of the extent to which the problems controlled by distinct statutory codes and administrative procedures are in fact interconnected. The authors recommend the concept of the Best Practicable Environmental Option (BPOE). This concept has been accepted in principle by the government of the United Kingdom, and might appear to provide a measure of coordination within the complicated web of law, institutions, and policies governing the control of pollution. The concept is examined and evaluated extensively in the light of the earlier device of Best Practicable Means (bpm) from which it was developed. It is concluded that BPOE is more powerful and of wider applicability than bpm, particularly if used as a standard setting and controlling mechanism instead of merely as a coordinating mechanism. (Author's abstract)
W87-05357

HEALTH RISKS BY BACTERIAL CONTAMINATION OF DRINKING WATER FOR DOMESTIC ANIMALS AND PROPOSED BACTERIOLOGICAL STANDARDS FOR WATER QUALITY (BAKTERIENBEDINGTE RISIKEN BEIM TRANK- UND BRAUCHWASSER UND VORSCHLAGE FUR STANDARDS),
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Tiermedizin und Tierhygiene.
For primary bibliographic entry see Field 5F.
W87-05371

RISKS FOR DRINKING AND APPLIED WATER CONDITIONED BY VIRUSES AND SUGGESTION FOR STANDARDS (VIRUSBEDINGTE RISIKEN BEI TRANK- UND BRAUCHWASSER UND VORSCHLAGE FUR STANDARDS),
Munich Univ. (Germany, F.R.). Fachbereich Medizin.
For primary bibliographic entry see Field 5F.
W87-05372

HYGIENIC ASPECTS OF WATER USED AT DAIRY FARMS (ZUR HYGIENE DES BRAUCHWASSERS BEI DER MILCHERZEUGUNG),
Tieraerztliche Hochschule Hannover (Germany, F.R.). Inst. fuer Hygiene und Technologie der Milch.
For primary bibliographic entry see Field 5F.
W87-05373

EVALUATION OF POLLUTION CONTROL LEGISLATION IN INDIA,
C. M. Abraham, and A. Rosencranz.
Columbia Journal of Environmental Law, Vol. 11, No. 1, p 101-118, Spring 1986. 86 ref.

Descriptors: *Legal aspects, *Water pollution control, *Legislation, *India, *Environmental protection, *Environmental policy, *Administration, Protection, Planning, Political constraints, Jurisdiction, Administrative agencies, Public policy, Law enforcement, Policy making, Decision making, Public participation, Standards, Adjudication procedure.

Weaknesses are pointed out in India's statutory scheme for environmental protection. Among topics discussed in this review are the structure of the government, early responses to pollution, the significance and prospective impact of India's pollution control laws, consent administration, constitution of the Central and State Boards, public participation, obstacles to judicial review, and the setting of standards. It is concluded that the country's bureaucratic structure is not entirely inadequate. The main problem lies in non-enforcement of existing laws; leadership and funding, together with certain changes in structure and enforcement, could enable India to approach the goals set forth at the United Nations' environmental conference in Stockholm in 1972. (Doria-PTT)
W87-05378

PLAYING THE ACID RAIN GAME: A STATE'S REMEDIES,
For primary bibliographic entry see Field 6E.
W87-05380

STATE AND FEDERAL LAND USE REGULATION: AN APPLICATION TO GROUNDWATER AND NONPOINT SOURCE POLLUTION CONTROL,
J. C. Buresh.
The Yale Law Journal, Vol. 95, No. 7, p 1433-1458, June 1986. 139 ref.

Descriptors: *Water law, *Water pollution sources, *Land use, *Regulations, *State jurisdiction, *Federal jurisdiction, *Groundwater pollution, *Water pollution control, *Nonpoint pollution sources, *Legal aspects, Social aspects, Zoning, Water pollution, Protection, Environmental protection, Economic aspects, Planning, Decision making, Policy making, Public policy, Legislation, Law enforcement, Administration, Administrative agencies.

Groundwater contamination and nonpoint source pollution of ground and surface waters are two of the most significant environmental problems of the 1980s. Nevertheless, because both types of pollution are intimately related to land use, Congress and state governments are reluctant to regulate them, since land use is commonly considered a purely local concern. It is argued that this reluctance is no longer justified. The legal doctrines and policy approaches developed by states to deal with the inadequacies of land use regulation in its environmental context can and should be applied to groundwater and nonpoint source pollution control. It is also suggested that, because the federal water pollution control effort cannot succeed without effective control of groundwater and nonpoint source pollution, federal water pollution control legislation must explicitly encourage and direct state regulation of defects in the local land use decision making process. (Author's abstract)
W87-05382

GLOBAL WATER ISSUES,
For primary bibliographic entry see Field 6B.
W87-05386

IRRIGATION MANAGEMENT FOR SOIL SALINITY CONTROL: THEORIES AND TESTS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 3C.
W87-05420

DETERMINATION OF THE PERMISSIBLE AMOUNT OF LIQUID ANIMAL WASTE APPLIED TO SOIL FILTERS,
Gdansk Technical Univ. (Poland). Inst. of Hyrdotechnics.
P. J. Kowalik, and H. Obarska-Pempkowiak.
Agricultural Water Management AWMADF, Vol. 10, No. 4, p 313-326, December 1985. 9 fig, 26 ref.

Descriptors: *Animal wastes, *Water pollution prevention, *Wastewater treatment, *Soil filters, *Biological oxygen demand, *Soil porosity, Wastes, Filters, Oxidation, Oxygen, Chemical oxygen demand, Oxygen demand, Organic wastes, Mathematical equations, Pollution load, Zones.

Protection against water pollution by agricultural wastes makes decomposition of organic effluents necessary. The problem of oxidation of liquid animal wastes in soil filters is described. The theory of oxygen diffusion in soil in which the oxygen consumption rates vary with time, was applied to determine the aerobic and anaerobic zones in the irrigated soil profile. The results of calculations for different biochemical oxygen demands (BOD) of pig slurry and for different soil air-filled porosity (eta sub g) allow the determination of maximum BOD loads for the given air porosity of soils. The permissible amount of organic pollutants as BOD sub 5 in wastewater is 0.2 kg/cu m for eta sub g = 0.10 cu m/cu m, BOD sub 5 = 0.9 kg/cu m for eta sub g = 0.20 cu m/cu m, and BOD sub 5 = 2.75 kg/cu m for eta sub g = 0.30 cu m/cu m. These limits were obtained under several assumptions, such as uniform distribution of air-filled porosity in the upper part of soil, oxygen respiration of soil similar to that of pig slurry, aerobic zone present in the upper 50 cm of the soil profile, and irrigation every 5 days. (Author's abstract)
W87-05436

ENGINEERING AND LEGAL RAMIFICATIONS OF GROUNDWATER CONTAMINATION - A CASE STUDY,
Dufresne-Henry, Inc., Concord, MA.
G. R. Allan.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 40, No. 5, p 409-414, October 1986. 2 fig.

Descriptors: *Groundwater pollution, *Water law, *Trichloroethylene, *Water wells, *Legal aspects, Interception, Massachusetts.

The town of Groveland, Massachusetts, lost its entire water supply (two gravel-packed wells) due to trichloroethylene contamination of 18 ppb and 10 ppb, respectively. The town has since replaced these sources with a new pumping station. The areas of contamination were determined by a field program and a restoration effort (interceptor wells) was designed and implemented. Legal aspects of this case also are discussed. (Rochester-PTT)
W87-05559

STATISTICAL METHODS FOR CALCULATING EFFLUENT DISCHARGE CONSENTS,
R. W. Crabtree, and I. D. Cluckie.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 81, Part 2, p 535-548, December 1986. 1 fig, 9 tab, 17 ref. SERC (England) Grant GR/B/87870.

Descriptors: *Effluent limitations, *England, *Wales, *Statistical models, *Rivers, *water quality, Water pollution control, Monte Carlo method, Mass balance equation, Consent setting methods.

Several disadvantages were identified in a survey and evaluation of the main consent setting techniques used by the regional water authorities in England and Wales. Within a probabilistic framework of river quality management and pollution control, consents should be set to meet local requirements such that the desired quality downstream of a discharge is met. Existing consent setting methods may be unsuitable or invalid in this context. A new scheme of consent setting, based on Monte-Carlo simulation of the mass balance equation, was developed. It mixes the appropriate distributions of the input data. The consent is then specified from the best statistical estimate of the 95 percentile of the resulting distribution. The majority of consents set using this scheme, applied to 33 sewage treatment works, were less conservative than the consents calculated using the techniques in common use. (Author's abstract)
W87-05566

DRINKING WATER ADDITIVES PROGRAM,
N. I. McClelland, and D. A. Gregorka.
Water Engineering and Management WENMD2, Vol. 133, No. 12, p 18-20, December 1986. 1 fig.

Descriptors: *Drinking water, *Additives, *National Sanitation Foundation, *Environmental Protection Agency, *Water quality standards, Administrative regulations.

Development by the National Sanitation Foundation (NSF) and a consortium of organizations of the Drinking Water Additives Program sponsored by the Environmental Protection Agency is explained. Funding, program objectives, the standards development process, program scope, schedule, and fees are described, and the product listing program and the problem of product grandfathering are discussed. The program will provide a single method of listing products established as 'safe' for use with drinking water. Participation will be voluntary and standards will be updated using established, objective, consensus procedures.

Following adoption of the Drinking Water Additive Standards, NSF will offer various services, including testing, evaluation, and listing of products; authorization to use and advertise with authorized, recognized NSF marks, and follow-up re-evaluation and sampling as required. (Rochester-PTT)
W87-05570

NEIGHBORLY HABITS AFFECT HOW EUROPE HANDLES SLUDGE,
International Construction, Sutton (England).
For primary bibliographic entry see Field 5E.
W87-05571

IN SITU TREATMENT OF GROUND WATER BY THE SUBTERRA METHOD,
E. Groba, and C. Vogler.
Water Well Journal WWJOA9, Vol. 40, NO. 11, p 61-62, November 1986. 1 fig.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Aeration, *Water treatment, *Aquifers, *Injection wells, *SUBTERRA system, Ammonia, Nitrate, Organic pollutants.

The SUBTERRA system of oxygen injection treats water underground to yield the following benefits: reversal of water quality deterioration resulting from subsurface pollutants such as NH4, NO3, or organic pollutants; increase the capacity of the production system (gravel pack, screens, pump, piping) by decreasing dissolved iron and manganese; and enhance natural purification of groundwater. The approach uses two wells. One well draws water of which 70-85% is used by the consumer and the other well is used to inject the remaining 15-30% of the water back into the aquifer after it is oxygenated with atmospheric oxygen. The roles of the two wells reverse periodically, depending on the contact time required for adequate treatment. If more wells are needed, the SUBTERRA treatment program can be expanded to up to 35 wells, grouped in sets of 5 wells each according to hydraulic characteristics. A computer coordinates the treatment cycle in multiwell systems. (Rochester-PTT)
W87-05579

DISASTER STRIKES CITY OF HERMITAGE TORNADO OF MAY 31, 1985,
J. A. Augustine.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 20, No. 1, p 5-6, January-February 1987.

Descriptors: *Tornadoes, *Pennsylvania, *Wastewater facilities, *Disasters, Emergency management, Insurance, Storms, Storm damage.

The effects of a tornado on the Hermitage, Pennsylvania, water pollution control included loss of electric power, degradation of treatment ability to only primary treatment (sludge settling), and additional expenses for rented equipment, gasoline, and overtime for staff. Steps to be taken to recoup disaster-related expenses from the federal, state, and local governments and private insurance carriers are: (1) file notice of interest through highest elected official; (2) obtain damage report from U.S. Army Corps of Engineers; (3) file a documented Damage Assessment Report; and (4) compile documentation of actions and expenses, and retain all records. (Rochester-PTT)
W87-05580

EFFECTS OF ADVANCED WASTEWATER TREATMENT ON RIVER WATER QUALITY,
Akron Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-05608

INEXPERIENCED WORKERS INJURY PRONE,
Water Pollution Control Federation, Alexandria, VA.
S. J. Hadeed.
Operations Forum, Vol. 3, No. 12, p 8-13, December 1986. 6 fig, 6 tab.

Descriptors: *Surveys, *Safety, *Accidents, *Employee training, *Training, *Wastewater treatment, Education, Wastewater, Wastewater facilities, Hazards.

Data taken from WPCF's 1986 Safety Survey revealed that the majority of wastewater injuries were caused by non-certified workers with 0 to 5 years of work experience. The wastewater field remained the most dangerous career fields since it had the highest incidence of injuries among all industries. Figures were presented for the number of injuries to various parts of the body, the types of injuries, and the wastewater systems in which the accidents occurred. A major issue which arose as a result of the study was the role of certification and training programs and how they affected safety performance. For the sixth consecutive year, systems with formal safety programs averaged 3.3 disabling injuries as compared to 0.5 for systems without such programs. Non-certified, inexperienced employees appeared to be principally involved in the majority of the accidents; most of those involved were employed at larger facilities with formal safety programs. (Wood-PTT)
W87-05609

LOW-COST LAB WORK,
J. W. Boyd, and T. W. Farrill.
Operations Forum, Vol. 3, No. 12, p 22-24, December 1986. 2 fig, 1 tab.

Descriptors: *Pollutant identification, *Colorimetry, *Laboratory equipment, *Cost analysis, *Testing procedures, Wastewater treatment, Wastewater, Economic benefits, Costs, Economic aspects, Estimated costs, Wastewater facilities, Metals, Ions, Standards, Specifications.

Producing laboratory results acceptable to regulatory agencies is costly for any wastewater treatment plant, but it can be a serious financial burden for small plants, especially for those receiving wastes from metal platers and similar industries. However, it was found that colorimetric test methods for metal ions offer a way to comply with the U.S. Environmental Protection Agency's (EPA) pretreatment and National Pollution Discharge Elimination System (NPDES) testing requirements and still remain within the budget. Colorimetric testing, or colorimetry, involves the use of laboratory reagents that produce a color when they react with specific chemicals or ions. The depth of color produced is proportional to the concentration of the test substance. A sample of savings expected by one facility and common errors in checking for accuracy were presented. (Wood-PTT)
W87-05611

BIOLOGICAL METHODS FOR THE RESTORATION OF CONTAMINATED AQUIFERS,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
M. D. Lee, and C. H. Ward.
Environmental Toxicology and Chemistry ETOCDK, Vol. 4, No. 6, p 743-750, 1985. 1 fig, 1 tab, 34 ref.

Descriptors: *Biological water treatment, *Aquifers, *Groundwater, *Water treatment, *Reviews, *Biodegradation, *Organic compounds, Microorganisms, Oxygen, Nutrients, Acclimatization, Bacteria, Field tests.

Contamination of aquifers is a serious threat to groundwater supplies. Once an aquifer is contaminated, it may remain so for many years. Biological methods for restoring aquifers polluted by organic compounds offer a promising solution. Techniques such as in situ treatment by stimulating the indigenous microbial population or withdrawal of the contaminated groundwater and treatment by conventional wastewater treatment processes have been used successfully. Mutant and acclimated microorganisms can be used in these systems in attempts to increase the rate of degradation of recalcitrant compounds. Stimulation of the indigenous microbial population by the addition of oxygen and nutrients has been shown to be effective in the removal of petroleum products, iron and manganese, and organic solvents. Acclimated and mutant strains of bacteria have been inoculated into treatment reactors and into soil to degrade various organic chemicals. Polluted groundwater also has been withdrawn and treated by activated sludge processes. While some of these processes have not been adequately tested under field conditions and may be limited in applicability, biological methods are effective in restoring some contaminated aquifers. (Author's abstract)
W87-05632

METABOLIC DIVERSITY AND ACTIVITY OF HETEROTROPHIC BACTERIA IN GROUND WATER,
Dayton Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 2F.
W87-05634

NATIONAL ENVIRONMENTAL POLICIES AND RESEARCH PROGRAMS: A COMPARISON AMONG SELECTED COUNTRIES.
MITRE Corp., McLean, VA.
Technomic Publishing Co., Inc., Lancaster, Pennsylvania, 1983. 160 p.

Descriptors: *International commissions, *Environmental protection, *Environmental policy, *Waste management, *Water pollution prevention, Air pollution, Noise, Wildlife conservation, Wildlife management, International agreements, Water pollution control, Water quality management.

Environmental policies, environmental protection strategies, major environmental issues, and research organizations and programs in Canada, the Federal Republic of Germany, Japan, Sweden, the United Kingdom, and the United States are reviewed. Environmental protection strategies discussed relate to air pollution, water pollution, noise, waste management, and the protection of wilderness values. Canada's environmental concerns have historically been related to its extensive land and abundant waters. There is increasing recognition of Canada's leadership in environmental assessment. The environmental policies of the Federal Republic of Germany are directly tied to its geographical and historical position as a center for economic and industrial development. An emerging environmental principle in the Federal Republic of Germany is that of pollution prevention. In Japan, priority has been given to the abatement of air pollution and to the control of toxic substances. Overall national policy in Sweden focuses on preservation of the unique wilderness characteristics of the country. The United Kingdom supports a system of voluntary compliance to protect the environment. British environmental laws and public concerns focus a great deal of attention on the preservation of rural amenities from impact by development. The United States relies on precisely defined pollution control standards to protect the environment. Some major policies and issues which will require international cooperation in the future (tourism, acid rain, carbon dioxide, ozone, and forest losses) are discussed. (Geiger-PTT)
W87-05715

HISTORICAL BLM MANCOS SHALE MANAGEMENT IN NW, CO.,
Bureau of Land Management, Meeker, CO.
C. W. Leet.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 2-18 to 2-27, 2 tab, 9 ref.

Descriptors: *Water quality control, *Mancos Shale, *Colorado, *Wolf Creek, *Erosion control, Watersheds, Runoff rates, Salinity, Soil stabilization.

The Bureau of Land Management (BLM) has been implementing salinity and erosion control structures in the Lower Wolf Creek (LWC) watershed for the past 40 years. The LWC watershed has a semi-arid climate and sparse vegetation. It is characterized by highly erodible Mancos Shale, a

marine sedimentary formation that is exposed on the surface and contains a high concentration of soluble salts. In this 31,858-ha (78,720-acre) watershed, about 80 projects have been completed to reduce erosion which accelerated because of overgrazing by cattle, sheep, and horses, from approximately 1897 tp 1936. Project work was started in 1938 by the Civilian Conservation Corps (CCC) and has continued sporadically by the BLM to the present. Stabilization techniques include contour furrows, reseedings, spreader dikes, detention and retention dams, pit reservoirs, and gully plugs. Many of the original erosion control projects have silted full, but most are still functional in slowing runoff velocities and depositing sediment. Some of the old reservoirs have spillways that are too steep, and the spillways are eroding into the existing reservoirs and are threatening the stability of the stored sediment. In 1984 the Lower Creek Watershed Management Plan (LWC WMP) was written to develop a systematic approach to salinity and erosion control from the discontinuous and continuous gully systems on the Mancos Shale Formation. The watershed was divided into treatment units for project implementation. Hypalon drop structures and new pit reservoirs are being designed for construction in 1985, and in the future, as funds become available for salinity control, and for the establishment of riparian habitat. (See also W87-05740) (Author's abstract)
W87-05752

SEDIMENT AND FORESTRY PRACTICES IN THE SOUTH,
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
For primary bibliographic entry see Field 2J.
W87-05753

HYDROPOWER IMPACTS ON EROSION AND SEDIMENTATION,
Corps of Engineers, Kansas City, MO. Kansas City District.
For primary bibliographic entry see Field 2J.
W87-05768

MISSOURI RIVER AGGRADATION AND DEGRADATION TRENDS,
Army Engineer District, Omaha, NE.
For primary bibliographic entry see Field 2J.
W87-05784

COLORADO RIVER SEDIMENT TRANSPORT IN GRAND CANYON,
For primary bibliographic entry see Field 2J.
W87-05786

CHANNEL ADJUSTMENTS OF THE LOWER COLORADO RIVER,
Bureau of Reclamation, Boulder City, NV.
For primary bibliographic entry see Field 4A.
W87-05802

OFFSITE SEDIMENT IMPACTS USING BASIN SCALE SIMULATION,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2J.
W87-05821

PRIORITIZING SURFACE WATER QUALITY PROBLEMS,
Agricultural Research Service, Morris, MN.
C. A. Onstad, R. A. Young, D. D. Bosch, and W. P. Anderson.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 302-310, 1 fig, 2 tab, 11 ref.

Descriptors: *Water quality, *Surface water, *Sediment transport, *Path of pollutants, Simulation analysis, Flow patterns, Nitrogen, Phosphorus, Chemical oxygen demand, Model studies.

A procedure was developed to establish priorities for potential water quality problems from agricultural watersheds. The procedure simulates flow and transport of sediment, nitrogen, phosphorus, and COD at points of interest within a watershed including the watershed outlet. Single storm events defined in terms of frequency and duration drive the model. The model uses geographic cells of data units at a resolution of 1 to 16 ha to represent upland and channel conditions. Within the framework of geographic cells, runoff characteristics are simulated together with the transport processes of sediment, nutrients, and COD. This framework permits the flow at any point in the watershed to be examined. In this manner, upland sources contributing to a potential problem can be identified and priorities set for initiating remedial measures to improve water quality most effectively. (See also W87-05791) (Author's abstract)
W87-05822

ENVIRONMENTAL ASPECTS OF SEDIMENTATION,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 2J.
W87-05834

NUTRIENT TRANSPORT BY SEDIMENT FROM PINE FORESTS,
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
For primary bibliographic entry see Field 2J.
W87-05841

HYPSOGRAPHS: BASIC TOOLS FOR LAKE MANAGEMENT AND MONITORING,
Environmental Protection Agency, Washington, DC. Office of Water Planning and Standards.
For primary bibliographic entry see Field 2H.
W87-05873

REGIONAL REFERENCE SITES: A METHOD FOR ASSESSING STREAM POTENTIALS,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W87-05874

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

SALINITY CONTROL AND DRAINAGE IN NORTHERN VICTORIA (AUSTRALIA),
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
For primary bibliographic entry see Field 5G.
W87-05194

CONTROLLING SALINITY IN THE COLORADO RIVER BASIN, THE ARID WEST,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
For primary bibliographic entry see Field 5G.
W87-05196

SALINITY CONTROL BY PUMPING AND DEEP WELL INJECTION - THE PARADOX VALLEY UNIT,
Bureau of Reclamation, Durango, CO.
For primary bibliographic entry see Field 5G.
W87-05197

AQUATRAIN PIPELINE SYSTEM,
Bureau of Reclamation, Denver, CO. Office of Saline Water Transport and Use.
For primary bibliographic entry see Field 5G.
W87-05210

SALT GRADIENT SOLAR PONDS.
Corps of Engineers, Tulsa, OK.
For primary bibliographic entry see Field 3C.
W87-05211

ISSUES IN GROUNDWATER MANAGEMENT.
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 4B.
W87-05219

SOME CHALLENGES AND OPPORTUNITIES IN GROUNDWATER MANAGEMENT,
For primary bibliographic entry see Field 4B.
W87-05228

DEMOGRAPHIC AND SOCIAL DIMENSIONS OF GROUNDWATER USE AND MANAGEMENT,
Texas A and M Univ., College Station. Dept. of Rural Sociology.
For primary bibliographic entry see Field 6D.
W87-05237

LARGE-SCALE OPTIMIZATION MODELS FOR GROUNDWATER MANAGEMENT,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W87-05240

USE OF CUMULATIVE SUM ANALYSIS TO ASSESS POLICY IMPACTS ON THE RIVER EBBW, WALES,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5G.
W87-05345

INTERACTIVE COMPUTER GRAPHICS-BASED MULTIOBJECTIVE DECISION-MAKING FOR REGIONAL GROUNDWATER MANAGEMENT,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
B. Datta, and R. C. Peralta.
Agricultural Water Management AWMADF, Vol. 11, No. 2, p 91-116, April 1986. 14 fig, 2 tab, 17 ref.

Descriptors: *Groundwater management, *Groundwater, *Computers, *Model studies, *Decision making, *Aquifers, Agriculture, Alternative planning, Rice, Arkansas, Mathematical equations, Mathematical studies, Water use, Costs, Selective withdrawal, Pumping.

A comprehensive set of procedures by which decision-makers can select a single strategy from a set of alternative strategies is presented. Application of these procedures in developing a regional conjunctive water management strategy for an important rice producing area in Arkansas, U.S.A., is described. The importance of interactive decision-making and efficient presentation of information through graphics and computations is also demonstrated. The optimization model considers two different objectives: minimization of the total cost of water use (including opportunity cost due to loss in agricultural production caused by non-availability of water); and maximization of total withdrawal (pumping) from the aquifer. Application of the surrogate worth tradeoff method together with interactive computer graphics display of relevant information is presented as part of the procedures for selecting a regional sustained groundwater withdrawal strategy. (Author's abstract)
W87-05447

STOCHASTIC IMPACTS ON FARMING: II. SEASONALLY CONTINUOUS PROBABILITY DISTRIBUTIONS,
For primary bibliographic entry see Field 3F.
W87-05529

STOCHASTIC IMPACTS ON FARMING: III. SIMULATION OF SEASONAL VARIATION OF CLIMATIC RISK,
Agricultural Research Service, Watkinsville, GA.
For primary bibliographic entry see Field 3F.
W87-05530

WATER BALANCE COMPUTATION IN WEST AFRICA: PROBLEMS AND PROSPECTS,
Lagos Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W87-05739

6B. Evaluation Process

GLENWOOD-DOTSERO SPRINGS SALINITY CONTROL PROJECT,
URS Co., Denver, CO.
For primary bibliographic entry see Field 5G.
W87-05201

SALINITY CONTROL ON THE SMOKY HILL RIVER IN CENTRAL KANSAS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5G.
W87-05202

LIVING WITH SALINITY: AN EVALUATION OF TWO POLICY MEASURES WITHIN A REGIONAL FRAMEWORK,
Hebrew Univ. of Jerusalem (Israel). Dept. of Agricultural Economics.
D. Yaron, and A. Ratner.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 441-454, 1 fig, 4 tab, 15 ref.

Descriptors: *Salinity, *Policy making, *Regional analysis, *Israel, Saline water, Cost analysis, Income, Management, Agriculture, Arid regions, Mathematical analysis, Crop production.

Yield and income losses accrued to farms under conditions of irrigation with saline water depend to a considerable extent on the farms' crop mix and the share of the salinity sensitive crops. When the share of the salinity sensitive is high, increasing salinity of irrigation water may become a serious economic problem. Proper management of irrigation and the introduction of new irrigation technologies may dampen the yield losses, but the adoption and application of counter-salinity irrigation methods is a slow and often costly process. Therefore, with water salinity exceeding a certain level, income losses are unavoidable. This fact and the general trend of deterioration of the quality of water resources prevailing in arid regions in numerous parts of the world provided the background and the motivation of this paper. The paper reviews two analyses of policy measures aimed at compensating for, or reducing, salinity induced losses in the agriculture, within a regional framework. The South and the Negev regions of Israel provided the empirical framework for the studies referred to. (See also W87-05165) (Lantz-PTT)
W87-05206

CONJUNCTIVE MANAGEMENT OF GROUND AND SURFACE WATER NEW MEXICO CASE LAW AND POLICY ISSUES,
New Mexico Univ., Albuquerque. School of Law.
For primary bibliographic entry see Field 4B.
W87-05232

ADDITIONAL LEGISLATIVE POWERS NEEDED BY UNDERGROUND WATER CONSERVATION DISTRICTS IN THE OGALLALA AREA,
McCleskey, Harringer, Brazill and Graf, Lubbock, TX.
For primary bibliographic entry see Field 6E.
W87-05236

WATER RESEARCH IN AUSTRALIA: NEW DIRECTIONS.
Australian Water Resources Council, Canberra.
For primary bibliographic entry see Field 6E.
W87-05251

WATER ISSUES FACING THE NATION: AN OVERVIEW.
General Accounting Office, Washington, DC.
GAO/CED-82-83, May 6, 1982. General Accounting Office, Washington, DC. 30 p, 2 append.

Descriptors: *Economic aspects, *Economic efficiency, *Operating policies, *Operating costs, *Water resources development.

The Federal Government has a tremendous stake in water resources in terms of capital investment and the physical and economic well being of the Nation. Traditionally the United States has built, maintained, and operated massive public works projects to solve its wate problems. But, this solution is becoming too expensive. The nation now faces the dilemma of ensuring adequate supplies of fresh water in the face of deteriorating facilities, inflating costs, and decreasing budjets. This study discusses the issues and problems relating to water resources and the perspective used by the General Accounting Office (GAO) in organizing its related audit efforts. Five issues are identified as requiring immediate attention; these are: what can the federal government do to help meet the Nation's water needs and make optimal use of its existing water resources; are water projects being developed and rehabilitated in the most economical and efficient manner; are water resources projects efficiently, effectively, economically, and safely operated; how can the Nation's navigation system be developed, operated, maintained, and managed in m,ore effective, economical, and efficient ways; are cost allocations, repayment, and financing policies for Federal water resources projects effectively meeting todays needs. (Author's abstract)
W87-05252

DECENTRALIZATION OF RISK MANAGEMENT: THE CASE OF DRINKING WATER,
Abt Associates, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W87-05273

ECONOMIC AND ENVIRONMENTAL PRINCIPLES AND GUIDELINES FOR WATER AND RELATED LAND RESOURCES IMPLEMENTATION STUDIES.
Water Resources Council, Washington, DC.
For primary bibliographic entry see Field 6E.
W87-05324

GLOBAL WATER ISSUES,
W. R. Rangeley.
Civil Engineering CEWRA9, Vol. 56, No. 12, p 60-62, December 1986.

Descriptors: *Water supply, *Water management, *Climates, *Drought, *Water quality management, *Soil erosion, *Sedimentation, Erosion, Irrigation, Conservation, Water conservation, Developing countries, Water pollution, Water supply development, Water resources development, Irrigation practices, Irrigation engineering, Engineering, Standards, Technology, Water shortage.

Five areas are reviewed where American experience and technology are of special importance in overcoming engineering problems pertaining to global water issues. These include: (1) climatic changes and drought; (2) soil erosion and sedimentation; (3) modernizing the vast numbers of old irrigation systems, since cultivating new land is possible only through water savings by existing users; (4) pollution and the problems of water quality; and (5) continued technical support for the United Nations program, the 'International Drinking Water Supply and Sanitation Decade'. (Author's abstract)
W87-05386

AGENDA FOR ECONOMIC RESEARCH ON FLOOD HAZARD MITIGATION,
Florida Univ., Gainesville. Dept. of Economics.
For primary bibliographic entry see Field 2E.
W87-05721

SOCIOLOGY RESEARCH NEEDS,
Denver Univ., CO. Dept. of Sociology.
For primary bibliographic entry see Field 6B.
W87-05722

SOCIOLOGY RESEARCH NEEDS,
Denver Univ., CO. Dept. of Sociology.
T. Drabek.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 107-133, 1 tab, 73 ref.

Descriptors: *Flood damage, *Flood forecasting, *Flood protection, *Social aspects, *Social impact, Social adjustment, Social costs, Social needs, Social participation, Project planning, Research priorities, Management planning, Flood plain management, Flood control, Education, Public policy.

The sociological research agenda on flood hazard mitigation is broad, multifaceted, and urgent. Four distinct phases of behavioral responses to flood hazard are identified: preparedness/mitigation, warning, emergency response, and recovery and restoration. The preparedness/mitigation phase involves policy formulation processes, policy response, and individual perceptions of hazard. The flood warning phase includes operational constraints such as flood warning system implementation as well as public evacuation plans. The emergency response phase requires research in the development of a multiorganizational response system, emergent group processes, and helping behaviors of family, therapeutic communities, and other agencies. The recovery and restoration phase encompasses such tasks as post-flood community decision-making, examination of long-term impacts on microsystems, and the processes of community and organizational change. These recommendations are cost-effective and theoretically additive. (See also W87-05716) (Geiger-PTT)
W87-05722

POLITICAL SCIENCE RESEARCH ON FLOOD MITIGATION,
Colorado State Univ., Fort Collins. Dept. of Political Science.
For primary bibliographic entry see Field 6E.
W87-05723

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

EVOLUTION OF A COST SHARING POLICY FOR FEDERAL CHLORIDE PROJECTS,
Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 5G.
W87-05167

ECONOMIC EVALUATION OF SALINITY CONTROL,
Corps of Engineers, Tulsa, OK.
R. D. Brown.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 125-134, 2 fig, 2 ref.

Descriptors: *Economic evaluation, *Salinity, *Water quality control, *Red River, River basins, Oklahoma, Texas, Arkansas, Louisiana, Saline water, Chlorides, Water pollution sources, Desalination, Brines, Project planning.

Natural chlorides in the Red River Basin emit from ten localized salt source areas that make up about two-thirds of the average daily load of 3,000,000 kg/day of chlorides entering Lake Texoma. Lake Texoma is the only main stem impoundment on the Red River and lies downstream of the emission areas. The natural salt pollution renders the basin resource unfit for most beneficial uses. Loads from each of the areas vary from about 43,500 kg/day at source area X in Texas to over 353,000 kg/day at source area VI in the Oklahoma portion of the

basin. Alternative concepts for the control of the brines developed in the early planning stages provided a wide variety of potential alternatives. These include diluting the concentrated flows with imported fresh waters, the construction of desalinization plants, transporting the brines from the emission areas to the gulf via pipeline, diversion of fresh water around the salt emission areas, and collecting the brine flows from the subsurface or surface and disposal of the concentrated brines at off-site containment reservoirs or by deep well injection. A methodology used, in part, to determine the economic merit of investments for removal of salt pollution in the Red River is demonstrated. The approach was developed as a basis to formulate studies for the Red River chloride control project. The evaluation demonstrates the amount of water demanded, when it is to be withdrawn, and the potential users. Formulation studies to determine the desirability of constructing pollution control measures included not only an economic evaluation, but also environmentl, social, and technical considerations. The results of those considerations showed that the Red River chloride control project should be constructed and that the estimated benefit-to-cost ratio is 1.6 to 1. (See also W87-05165) (Lantz-PTT)
W87-05176

AQUATRAIN PIPELINE SYSTEM,
Bureau of Reclamation, Denver, CO. Office of Saline Water Transport and Use.
For primary bibliographic entry see Field 5G.
W87-05210

CONNECTIONS BETWEEN GROUNDWATER AND ECONOMIC GROWTH,
Texas Univ. at Austin. Graduate School of Business.
For primary bibliographic entry see Field 4B.
W87-05221

EDWARDS UNDERGROUND WATER DISTRICT,
Fulbright and Jaworski, San Antonio, TX.
For primary bibliographic entry see Field 6E.
W87-05235

ECONOMIC IMPLICATIONS OF CHANGING GROUNDWATER USE PATTERNS,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
R. D. Lacewell, J. R. Ellis, and R. C. Griffin.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 269-296, 2 fig, 3 tab, 44 ref.

Descriptors: *Groundwater management, *Economic aspects, *Water use, *Alternative water use, *Economic impact, Irrigation, Agriculture, Water resources development, Available water, Gulf Coast Aquifer, Edwards Aquifer, Winter Garden Aquifer, San Antonio Aquifer.

In the West, 85% of total water withdrawals from surface and ground sources are for irrigated agriculture. Adjustments in water use most certainly will affect agriculture, which contributes to local and regional economic activities such as grain elevators, transportation, input supplies, food processing, and related sectors. Adjustments in water availability for irrigated agriculture raise issues as to the effect on local and regional communities as well as on economies. These economies may remain strong yet patterns of community life and business change dramatically. Such changes may have serious social effects on those of a community that did not choose the change. Groundwater use, value of water in alternative uses, economic impacts of adjustment (on agriculture, community and other economic sectors) are discussed, with special focus on the Gulf Coast, Edwards, Winter Garden and San Antonio Aquifers. A conclusion that evolves from this report is that there is no single answer as to the economic impacts of changing groundwater use patterns. The effect depends upon the nature of the aquifer, characteristics of users, location, surface water availability, and many other factors. A few important impacts have been presented for three principal aquifers in Texas. These results cannot be extrapolated to other regions or aquifers. Each is a separate issue requiring a separate analysis and different management approaches. (See also W87-05219) (Lantz-PTT)
W87-05238

HOW TO USE PRIVATIZATION FOR A COMPOSTING PROJECT,
L. D. Shubnell.
Biocycle BCYCDK, Vol. 27, No. 6, p 44-46, July 1986.

Descriptors: *Financing, *Economic aspects, *Sludge treatment, *Cost analysis, *Bond issues, *Composting, *Wastewater treatment facilities, Maryland, Baltimore, Contracts.

The details of the procurement and financing activities that led to the Baltimore City Composting Facility are explained. It is based on the presentation given at the 16th National Composting and Waste Recycling Conference. The project's contractual structure and interrelationships among the parties were necessary elements in getting the bond to a point of being a marketable security in the public market. The variable rate/ fixed-rate demand bond has many underpinnings, and when the bond enters the public market the investor sees only the tip of the iceberg. However, this type of bond allows maximum flexibility and deserves attention. (Jessick-PTT)
W87-05302

COST COMPARISON BETWEEN CONVENTIONAL AND DETAINED DRAINAGE SYSTEMS,
UMA Engineering Ltd., Burnaby (British Columbia).
For primary bibliographic entry see Field 4A.
W87-05470

SOCIAL BURDEN OF WEATHER AND CLIMATE HAZARDS,
Colorado Univ. at Boulder. Natural Hazards Research and Applications Information Center.
W. E. Riebsame, H. F. Diaz, T. Moses, and M. Price.
Bulletin of the American Meteorological Society BAMIAT, Vol. 67, No. 11, p 1378-1388, November 1986. 7 fig, 4 tab, 81 ref.

Descriptors: *Social impact, *Hazards, *Climatology, *Social costs, United states, Tropical storms, Hurricanes, Flood damage, Tornadoes, Mortality, Qualitative analysis.

Socioeconomic vulnerabilities and impacts associated with weather and climate hazards in the United States are assessed. Trends in death and economic losses resulting from tornadoes, tropical storms and hurricanes, and floods (including flash floods) are presented. To the extent possible, death statistics are normalized by the population at risk and loss data are adjusted for inflation. The results suggest a significant decline in deaths attributed to tornadoes and hurricanes at the same time that property damage has increased. In contrast, both deaths and losses due to floods have increased substantially in the past few decades. A qualitative assessment of the effects of socioeconomic trends on the nation's sensitivity to atmospheric hazards and the need for better information about these hazards showed mixed impacts on vulnerability (ie, some trends decrease vulnerability while others increase it), but the impact on information needs was nearly uniformly greater. More emphasis should be given to the following activities: (1) improve the use of weather and climate information by emergency managers; (2) develop better impact-assessment methods, and (3) explore new ways to reduce future property losses. (Author's abstract)
W87-05546

DESIGN ASSUMPTIONS KEY TO EGG-SHAPED DIGESTER COSTS,
Pitt-Des Moines, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 5D.
W87-05574

6D. Water Demand

SALINITY CONTROL THROUGH WATER CONSERVATION IN THE UPPER COLORADO RIVER BASIN,
Utah State Univ., Logan. Coll. of Engineering.
For primary bibliographic entry see Field 5G.
W87-05187

CONNECTIONS BETWEEN GROUNDWATER AND ECONOMIC GROWTH,
Texas Univ. at Austin. Graduate School of Business.
For primary bibliographic entry see Field 4B.
W87-05221

SOME ISSUES IN INTERSTATE WATER TRANSFER: THE EL PASO CASE,
Vinson and Elkins, Austin, TX.
For primary bibliographic entry see Field 6E.
W87-05226

DEMOGRAPHIC AND SOCIAL DIMENSIONS OF GROUNDWATER USE AND MANAGEMENT,
Texas A and M Univ., College Station. Dept. of Rural Sociology.
S. H. Murdock, R. R. Hamm, and D. E. Albrecht.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 249-267, 1 tab, 49 ref.

Descriptors: *Groundwater management, *Water use, *Demographics, *Texas, Water resources development, Water conservation, Economic aspects, Political aspects, Water demand, Management planning, Public policy.

Groundwater resources are a major source of concern to Texans. The management of these resources requires careful consideration of a large number of dimensions and issues. Thus, the successful management of such resources requires careful consideration of engineering, hydrologic, climatological, economic, conservation, and numerous other parameters and factors. Most analyses, however, have emphasized the hydrologic, engineering and economic dimensions. However, the complexity of the water issue suggests that such a perspective may be simplistic. Social, demographic, and political considerations are likely to be equally important to effective planning and program implementation. The consequences of failing to address the demographic and social dimensions of water demand and use and water policy formulation are substantial. Inadequate planning information, inequity in program implementation, and public rejection may result from such omissions. On the other hand, increased accuracy in water-related projects, increased sensitivity to the context and clientele served by water development planning, and a reduced risk of project rejection can result from the careful inclusion of such dimensions. Although substantial research is necessary to establish the empirical linkages between such factors and characteristics of water use, demand, and program implementation, it appears that once such linkages are established, it will be possible to use demographic and social factors to increase the understanding of the complex circumstances affecting water use and development, and to ensure that groundwater and other resources are more effectively used. (See also W87-05219) (Lantz-PTT)
W87-05237

GREAT LAKES DIVERSION AND CONSUMPTIVE USE: THE ISSUE IN PERSPECTIVE,
Center for the Great Lakes, Chicago, IL.
For primary bibliographic entry see Field 4A.
W87-05361

INTER AND INTRASTATE USAGE OF GREAT LAKES WATERS: A LEGAL OVERVIEW,
Chicago-Kent Coll. of Law, IL.
For primary bibliographic entry see Field 6E.
W87-05363

WATER REQUIREMENTS IN ANIMAL HUSBANDRY (DER BEDARF AN TRANK- UND BRAUCHWASSER IN DER TIERHALTUNG),
Tieraerztliche Hochschule Hannover (Germany, F.R.). Inst. fuer Tierhygiene.
H. G. Hilliger.
Deutsche Tierarztliche Wochenschrift, Vol. 93, No. 7, p 283-286, July 1986. 1 fig, 8 tab, 44 ref.

Descriptors: *Water demand, *Water use, *Drinking water, *Livestock, *Dairy industry, *Planning, *Water management, Farms, Domestic animals, Hogs, Poultry, Sheep, Cattle, Growth.

The consumption of drinking water depends not only on the type and age of the animals but also on the feeding and keeping conditions. Data are reported for cattle, pigs, and poultry from the literature, with information on the losses of drinking water and the effects of water restriction and starvation on the animals. Tap water is needed in dairy farming and for cleansing as well as for drinking. Proposals for planning requirements for tap water are given. (Author's abstract)
W87-05369

BEHAVIOUR-ADAPTED DRINKING WATER SUPPLY IN CATTLE AND SWINE (VERHALTENSANGEPASSTE TRINKWASSERVERSORGUNG VON RINDERN UND SCHWEINEN),
Technische Univ. Muenchen (Germany, F.R.). Landesanstalt fuer Landtechnik.
J. Boxberger.
Deutsche Tierarztliche Wochenschrift, Vol. 93, No. 7, p 286-289, July 1986. 8 fig, 2 tab, 5 ref.

Descriptors: *Water demand, *Water supply, *Cattle, *Hogs, *Livestock, *Drinking water, *Animal behavior, Behavior, Temperature, Water temperature, Physical properties.

Adaptation can be only a partial aspect in the drinking behavior of cattle and swine, because in the construction of drinking facilities some other criteria are masking it. This especially applies to swine keeping, where tidiness often is a problem and the less behavior-adapted systems are sometimes preferred. In cattle farming, the adaptation to specific behavioral patterns leads to improved water supply. Extensive investigations have provided a data base for the construction of drinking facilities. The influence of different water qualities was also tested. (Author's abstract)
W87-05370

CROP WATER USE DATA AVAILABLE FROM THE SOUTHEASTERN USA,
Agricultural Research Service, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
E. J. Sadler, and C. R. Camp.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1070-1079, July-August 1986. 2 fig, 7 tab, 160 ref.

Descriptors: *Data collections, *Water use, *Reviews, *Southeastern US, *Soil profiles, *Lysimeters, Rainfall, Runoff, Irrigation management, Technology transfer.

Crop water use data were extracted from literature data originating in the southeastern U.S. Data were catalogued according to location, method of measurement, crop, time, duration of study, form of data, main treatments, and concurrent data published. In all, 101 unique crop-experiment citations were located. The following locations, in four states, accounted for 56 of these: Pontiac, SC; Thorsby, AL; Ft. Lauderdale and Belle Glade, FL; and Raleigh and Waynesville, NC. Soil profile methods were used in 39; lysimeters were used in 44. The soil profile method of determining water use has been criticized for susceptibility to errors under high rainfall conditions common to the southeastern U.S. Experimental methods were not always completely described, so limitations of the data were not always clear. A few citations included discussions of the limitations; most common was lack of fetch or conditions non-representative to field crops. From the review, it can be concluded that a conclusive study is lacking in the physiographic area. It is also considered that insufficient data exist for a conclusive test of transferability of western irrigation management technology into the more humid Southeast. (Author's abstract)
W87-05537

COMPUTER-ASSISTED MAPPING OF IRRIGATION WATER REQUIREMENTS FOR VANCOUVER ISLAND BASED ON SOIL AND AGRICULTURAL CAPABILITY SURVEY DATA,
British Columbia Ministry of Environment, Victoria. Water Management Branch.
For primary bibliographic entry see Field 3F.
W87-05878

6E. Water Law and Institutions

LEGAL AND INSTITUTIONAL CONSTRAINTS TO SALINITY CONTROL,
Bureau of Reclamation, Provo, UT. Utah Projects Office
For primary bibliographic entry see Field 5G.
W87-05170

SOME ISSUES IN INTERSTATE WATER TRANSFER: THE EL PASO CASE,
Vinson and Elkins, Austin, TX.
P. Schenkkan, and L. Wilson.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 93-109, 2 fig, 3 tab, 6 ref.

Descriptors: *Interstate compacts, *El Paso, *Water transfer, *Management planning, *Texas, *Water demand, New Mexico, Water use, Rio Grande River, Reservoirs, Water storage, Texas, Water supply, Water conservation.

El Paso and its neighbors in New Mexico are presently engaged in a complex process of institutional change involving water. This process illustrates basic trends in contemporary water resource management: urban development and agricultural resistance; the increasing importance of economics as a measure of appropriate allocation of available water resources; the use of markets to mediate supply and demand pressure; and increasing pressure on governments to become a neutral regulator of these markets instead of subsidizing and protecting politically favored water users. El Paso's total need for water in 50 years could approach 300,000 acre-ft/yr (AFY), or about three times the present value. This is pumped water. At least half is not consumed, but is collected in the sewer system, where it can be treated and made available for agriculture or other reuse. While El Paso is overwhelmingly economically dominant in its region, agriculture remains an enormous user of the scare regional water supplies. The Rio Grande Project consists of the waters of the Rio Grande stored in Elephant Butte and Caballo Reservoirs, and related canals and diversion and distribution facilities which extend throughout the Valley area. The Rio Grande Project is an interstate project. The Bureau of Reclamation schedules releases to provide the same amount of delivered project water/acre to each project user, whether a New Mexico farmer, a Texas farmer, or the City of El Paso. Project water for this purpose includes surface water return flows (e.g., irrigation runoff and municipal effluent discharges), less seepage, and other transmission losses. Thus, through the project, a partial water balance mechanism has been functioning in the interstate El Paso region for many years. The project's water budgeting is not, however, complete. Project water does not include groundwater, heavily utilized by New Mexico farmers from thousands of shallow valley alluvium wells and by El Paso from deeper wells. Existing water supplipes, conservational and recycling and new supplies are discussed with respect to this project. (See also W87-05219) (Lantz-PTT)
W87-05226

EMERGING LEGAL CHALLENGES FOR GROUNDWATER MANAGEMENT,
Texas Tech Univ., Lubbock. School of Law.
F. F. Skillern.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 137-163, 99 ref.

Descriptors: *Legal aspects, *Groundwater management, *Legislation, *Water use, Water demand, Policy making, Political aspects, Groundwater budget, Public policy, Public participation, Water management.

The technical and legal issues confronting groundwater management are not simple ones. Whether control techniques exist to handle pollution from nonpoint sources, such as agricultural or mining activities, is unclear. How to legally control them is also unanswered. Groundwater management programs will require close cooperation between scientists, engineers, and lawyers. The political nature of groundwater management problems cannot be ignored. Current users from industrial, municipal, agricultural, and other sectors are concerned about maintaining their use. At the same time, demand for groundwater for new uses is increasing. Any management system must recognize the need to accommodate existing uses, to conserve and enhance available groundwater supplies, and to protect them from future contamination. Preventive measures through planning or regulation are almost always less expensive than remedial action after contamination, salt water intrusion, or subsidence has occurred. A management program must seek at least those objectives in order to assure industrial and economic growth essential to society. The legal challenges are not insurmountable, but they are complex. Many answers to the challenges will be political ones. A successful program should be developed by participation of all parties affected. Acknowledging and inviting public, industrial, scientific, technical, and legal participation will provide a better chance for a workable program. A management system that recognizes the public interest by allowing active involvement by affected parties has the potential for better decisions based on more accurate and complete information. That type of system is more likely to attain its objectives and the support of those regulated as well as of the public. In the final analysis, that support may be critical to the success of any groundwater management system. (See also W87-05219) (Lantz-PTT)
W87-05229

LESSONS FROM THE REST OF THE WEST: A SURVEY OF GROUNDWATER MANAGEMENT IN CALIFORNIA, COLORADO, NEW MEXICO, AND NEBRASKA,
Chicago-Kent Coll. of Law, IL.
For primary bibliographic entry see Field 4B.
W87-05230

DEVELOPMENT OF THE NEW ARIZONA GROUNDWATER CODE,
Arizona Dept. of Water Resources, Phoenix.
K. Ferris.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 175-196, 122 ref.

Descriptors: *Arizona, *Groundwater management, *Legislation, Legal aspects, History, Administration, Water conservation, Groundwater mining, Costs.

On June 11, 1980, the Arizona Legislature passed the Groundwater Management Act. The act made the first significant changes in the state's groundwater laws in thirty-two years. The bulk of the act

was a comprehensive new groundwater code that is unique in the United States in its ambitious approach to groundwater management. This paper summarizes the history of the code and its major provisions, and addresses the law's constitutionality and its usefulness as a model for other states. The major provisions discussed are: (1) administrative structure; (2) acquiring rights to use groundwater; (3) management plans and mandatory conservation; (4) assured water supply; (5) water measuring devices; (6) groundwater withdrawal fees; and (7) enforcement codes. (See also W87-05219) (Lantz-PTT)
W87-05231

CONJUNCTIVE MANAGEMENT OF GROUND AND SURFACE WATER NEW MEXICO CASE LAW AND POLICY ISSUES,
New Mexico Univ., Albuquerque. School of Law.
For primary bibliographic entry see Field 4B.
W87-05232

LEGISLATIVE PERSPECTIVE ON TEXAS GROUNDWATER: CONSTRAINTS AND POSSIBILITIES,
Texas Office of the Lieutenant Governor, Austin.
For primary bibliographic entry see Field 4B.
W87-05233

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT: A REPORT ON ITS CREATION, POWERS, LIMITATIONS OF POWERS, AND PROGRESS,
Butler and Binion, Houston, TX.
R. Callaway.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 225-235, 5 ref.

Descriptors: *Harns-Galveston Coastal Subsidence District, *Groundwater management, *Management planning, Harris County, Galveston County, Texas, Aquifers, Water resources development, Water use, Water demand, Legal aspects, Public policy, Regulations, Water transport, Costs.

Harris and Galveston counties historically have relied heavily on local groundwater for municipal and industrial supplies. Prolonged pumping caused the potentiometric surface of the aquifer system beneath the area to decline over a broad region. This decline caused one of the largest subsidence bowls in the United States. Approximately 4,700 sq mi of land subsided more than 0.5 ft from 1943 to 1973. Maximum subsidence in the region approximated 10 ft. Water level declines in the aquifer system of 450 ft were measured. More than 31 sq mi of low lying coastal land was permanently inundated. The potential for tidal flooding, particularly from storm surges, increased in the coastal region because of loss of elevation. The center of groundwater pumping in the district has shifted from the Ship Channel to the Galleria area of Houston and southwest Houston and Harris County. There is considerable pumpage in extreme northwest and west Harris County where pumpage is primarily for agricultural purposes although significant urban development is anticipated. Within the district's boundaries, there is considerable groundwater pumping caused by urban development, heavy industry, and agricultural needs. This combination is unique. Concern about the practical consequences of subsidence remained restricted to technical circles until the late 1960s and early 1970s when the relation between land subsidence and inundation and the increased hazard from tidal surges in the coastal area became obvious. It was in response to these concerns that the Harris-Galveston Coastal Subsidence District was created. Provisions of the Harris-Galveston Act, limitations of the Harris-Galveston Subsidence District, regional regulations, water costs and transport, and administration are discussed. (See also W87-05219) (Lantz-PTT)
W87-05234

EDWARDS UNDERGROUND WATER DISTRICT,
Fulbright and Jaworski, San Antonio, TX.
M. Q. Kelly.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 237-241.

Descriptors: *Edwards Aquifer, *Aquifer management, *Water districts, *Legal aspects, Groundwater management, Legislation, Cost analysis, Water resources development, Groundwater management.

Motivated in part by the severe drought of the 1950's, the South Texas Chamber of Commerce in 1955 established the Edwards Underground Water Committee. The committee promoted the formation of an underground water conservation district in the area of the Edwards Aquifer. The district was created as a conservation and reclamation district pursuant to Article XVI, Section 59 of the Texas Constitution. The District's Act was amended by the 66th Legislature in 1979 and again by the 68th Legislature in 1983. Included in the act are provisions for a fifteen-member board of directors, including three directors elected from each of the five county areas of the district. The statute authorizes the district to levy annually an ad valorem tax established by the statute at $.02/$100 of assessed valuation; with voter approval, the district may levy ad valorem taxes up to $.25/$100 of assessed valuation. The Edwards Underground Water District's purpose and powers are being subjected to scrutiny now more than at any other time in its history. Those powers are stated in Section 3 of the District's Act. The district has broad authority to 'conserve, protect and increase the recharge of and prevent the waste and pollution of the underground water'. Other specified powers of the district include the power to acquire land and easements by purchase or by eminent domain for the erection of dams, and to drill and equip wells and pumps to recharge the aquifer. (See also W87-05219) (Lantz-PTT)
W87-05235

ADDITIONAL LEGISLATIVE POWERS NEEDED BY UNDERGROUND WATER CONSERVATION DISTRICTS IN THE OGALLALA AREA,
McCleskey, Harringer, Brazill and Graf, Lubbock, TX.
D. Graf.
IN: Issues in Groundwater Management, Water Resources Symposium Twelve, Center for Research in Water Resources, The University of Texas at Austin, Austin, Texas. 1985. p 243-246.

Descriptors: *Legislation, *Ogallala Aquifer, *Water conservation, *Groundwater management, Pumping, Irrigation, Groundwater pollution, Texas, Costs, Well permits, Management planning, Legal aspects.

The first underground water conservation district in the Ogallala area was established in 1951. This was the High Plains Underground Water Conservation District No. 1. Two other major districts have been established since that time, namely the North Plains Underground Water Conservation District and the Panhandle Underground Water Conservation District. Many conservation changes have been encouraged and instituted by the various conservation districts. Included among these practices are the virtual elimination of tailwater waste and new sources of underground water pollution from oil field activities; the utilization of sprinkler systems which are water conservers; pumping equipment tests to insure efficient utilization of water; vast educational programs for adults and school children; and research into areas of additional conservation, such as the utilization of surge irrigation equipment, furrow dikes, and other methods. Against this background of conservation success, the author suggests the following legislative changes to ensure continued progress. (1) Create underground water districts under all of the Ogallala area as well as the other underground water areas of the state of Texas. (2) Strengthen the definition of the term'waste' as currently contained in section 52.001 of the Texas Water Code. (3) The ability to fine violators of board rules and regulation. (4) The ability to authorize new well permits only if the user can demonstrate proof of need for such a permit. (5) Subject well size to the jurisdiction of an underground water district (should be decreased from the current 100,000 gallons/day limitation to a much lower figure such as 25,000 gallons/day). (6) Underground water districts should be given the power to purchase, sell, transport, and distribute both surface and groundwater. (7) Provide additional funding, through the legislature, for research. (See also W87-05219) (Lantz-PTT)
W87-05236

ECONOMIC IMPLICATIONS OF CHANGING GROUNDWATER USE PATTERNS,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6C.
W87-05238

DEEP WELL INJECTION OF INDUSTRIAL HAZARDOUS WASTE IN TEXAS,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 5E.
W87-05246

EPA'S GROUNDWATER PROTECTION STRATEGY,
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 5G.
W87-05249

WATER RESEARCH IN AUSTRALIA: NEW DIRECTIONS,
Australian Water Resources Council, Canberra.
Australian Water Resources Council Water Management Series No. 1. Australian Government Publishing Service, Canberra, Australia. 1982. 76 p, 3 fig, 4 tab, 50 ref, append.

Descriptors: *Water resources, Australia, *Policy, *Research, *Management planning, *Planning.

Changing demographic, social and economic conditions have pushed the Australian water industry into a new phase. The industry is moving now from an era of development to one of management. As a result substantial problems are emerging, and an industry which was geared towards engineering solutions is not well placed to solve them. Resolution of emerging problems will require a better understanding of the social and economic aspects of water management with respevct to the ecology of the aquatic environments, and the development of techniques necessary for the joint management of land and water resources. In the past Australia has been able to rely on research carried out in other countries, however, this is not possible with water resources owing to the unique aquatic environment. Four main issues were considered: who should do the research; what additional funds are necessary; what programs should be funded; and what are the most desirable management arrangements. It was recommended that all governments, Federal, State and local, recognize the vital importance of water and assign a higher priority to water research; and the target level of annual expenditure from all sources on water research be $30 million by 1984/85. It was also recommended that the Commonwealth Government formulate a water research policy to provide for the development of co-operative research programs with other Australian water institutions; insure necessary leadership by establishing a National Water Research Council; support this council by establishing a National Office of Water Research in the Department of National Development and Energy; develop a new program to replace the AWRC Water Research Program; increase the rescorces available to CSIRO; and develop appropriate co-ordination arrangements between AWRC, the National Office of Water Research, CSIRO and Bureau of Mineral Resources; Geology and Geophysics. For the State governments it aws recommended that they increase their capital expenditue to $10.5 million per

annum by 1984/85; strengthen the research capacities of water agencies; develop or strengthen arrangements for the determination of priorities for and co-ordination of State water research; and support the establishment of the Australian Institute of Urban Water Studies. (Ram-PTT)
W87-05251

WATER ISSUES FACING THE NATION: AN OVERVIEW.
General Accounting Office, Washington, DC.
For primary bibliographic entry see Field 6B.
W87-05252

DECENTRALIZATION OF RISK MANAGEMENT: THE CASE OF DRINKING WATER,
Abt Associates, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W87-05273

HISTORIC RELATIONSHIP OF WATER QUANTITY AND WATER QUALITY,
Vranesh and Raisch, Boulder, CO.
G. Vranesh.
Natural Resources and Environment, Vol. 1, No. 4, p 3-5, 46-48, Winter 1986.

Descriptors: *Water quality, *Water supply, *Legal aspects, *Riparian rights, *Water law, Appropriation, State jurisdiction, Federal jurisdiction, Federal water Pollution Control Act, Clean Water Act, Water pollution, Effluent limitations, Eastern states, Western states, Water law.

An overview of the historical development of the law relating to water quantity and quality is presented. Initially, the only legal method of allocating water in America was the riparian doctrine which originated from English common law and was adopted by the eastern states. As water law made its way westward, two riparian principles, reasonable use and appurtenancy, did not survive. Despite these differences, eastern and western sates shared the belief that the right to control the use of water was a matter of state law. The primary distriction in water pollution laws came to be federal-state concerns. A guiding principle in water pollution cases provided that no water use should significantly impair water quality for any subsequent use. The first federal statutes on water pollution were enacted before the turn of the century and the next major action took place with the Federal Water Pollution Control Act enacted in 1948. The Clean Water Act enacted a permit program for controlling effluent discharges based on technological limitations. State and local governments have had to adjust their traditional control over land and water use matters to accommodate growing federal invovement in water quality control. Sections 208 and 404 of the Clean Water Act are being used to dictate to the states what water projects will be constructed and how water uses will be regulated. Nearly any use of water decreases quality in some respect and cooperation rather than conflict is needed to ensure maximum use of a valuable natural resource. (Michael-PTT)
W87-05286

WESTERN WATER LAW,
R. E. Walston.
Natural Resources and Environment , Vol. 1, No. 4, p 6, 8, 48-52, Winter 1986.

Descriptors: *Water law, *Western states, *Riparian rights, Water rights, Appropriation, State jurisdiction, Federal jurisdiction, California, Water allocation.

The basic tenents of Western water law and the ways in which they have changed to meet growing economic needs and an increased environmental awareness are discussed. The appropriation doctrine has been statutorily codified in all Western states which administratively regulate water rights. The Supreme Court has held that the Federal Government has a reserved right to use water on federal lands for specified federal purposes, and riparian rights have recently been claimed for secondary reservation purposes. The quantification of reserved water rights has posed several problems and it is questionable whether Congress, in enacting laws to serve federal reclamation and power interests, intends to either preempt state water laws or to accommodate them. A special problem is posed with respect to interstate relations over water allocation. States with competing claims to interstate water may enter into a compact that apportions water or may litigate the apportionment issue before the Supreme Court. A recent concern has arisen over environmental values threatened by increased consumptive uses of water. Congress and the Western states have adopted a number of measures to protect instream uses, and the question has arisen whether a state has the right to revoke or modify existing water rights to protect instream uses. Traditional appropriation and riparian doctrines have been changed to accommodate the West's growing economic development, increased environmental awareness and new federal constraints on state water allocations. (Michael-PTT)
W87-05287

EASTERN WATER LAW,
Office of the Associate Attorney General, Washington, DC. Land and Natural Resources Div.
G. W. Sherk.
Natural Resources and Environment, Vol. 1, No. 4, p 7, 9-11, 52-57, Winter 1986.

Descriptors: *Eastern states, *Water law, Riparian rights, Permits, Groundwater, Water use, Water conservation, Water demand, Water consumption, Water allocation, Reviews.

Current laws and proposed legislation concerning allocation and management of water resources in 26 Eastern states are reviewed. The traditional riparian doctrine has several disadvantages in protecting and allocating scarce water resources. State laws and regulatory approaches covering several aspects of water resources management are examined, including permit and registration requirements for surface water uses, threshold use amounts, the definition of allowable water uses, the distinction between temporal priority and preferences based on specific water uses, area of use and diversion restrictions, minimum water levels, water conservation and conjunctive uses. It is concluded that existing laws in Eastern states will be strngthened as quantity and use exemptions are eliminated, water conservation will grow in importance, alternative dispute resolution mechanisms will continue to develop, temporal priority will become the predominant approach for water use allocation and regional approaches to the management and allocation of water resources will continue to develop. (Michael-PTT)
W87-05288

WHAT WATER QUALITY LAWYERS SHOULD KNOW ABOUT WATER LAW,
A. M. Rovick.
Natural Resources and Environment, Vol. 1, No. 4, p 12-15, Winter 1986.

Descriptors: *Water law, *Water quality, Appropriation, State jurisdiction, Federal jurisdiction, Groundwater, Water use.

The evolution of water law is discussed in terms of doctrines such as appropriation and minimum instream flows that have shaped the body of regulation on water use. A basic principle is that states have sovereign authority to regulate the water within their jurisdiction, but the growing application of Federal reserved water rights may create a confrontation between state and federal control over surface waters. The reasonable use doctrine limits traditional rights of absolute ownership of groundwater. The correlative rights doctrine introduces the concept of pro rata sharing of resources among the groundwater owners overlying an aquifer. Water scarce Western states have commonly enacted statutes to prohibit transport of groundwater from the state of origin, but a recent court decision holding that water is an article of interstate commerce could portend a significant shift in groundwater regulation from the states to the Federal Government. (Michael-PTT)
W87-05289

WHAT WATER LAWYERS SHOULD KNOW ABOUT WATER QUALITY,
Hill and Robbins, Denver, CO.
D. W. Robbins, and D. M. Montgomery.
Natural Resources and Environment, Vol. 1, No. 4, p 16-18, 57, Winter 1986.

Descriptors: *Water law, *Water quality, Federal Water Pollution Control Act, Permits, Western states, Water rights, State jurisdiction Federal jurisdiction, Environmental policy, Appropriation.

Legislation and court decisions that have shaped water quality law are reviewed. The most significant piece of water quality legislation is the Federal Water Pollution Control Act (FWPCA) which created a permit program to regulate discharges of pollutants from point sources. The 1972 amendments to the FWPCA raised some novel legal issues in accommodating discharge limitations with the prior appropriation doctrine, particularly in cases where discharges would find it necessary to increase water consumption in order to comply with discharge limitations. The dredge and fill permit provisions of the amendments also affected water rights and the water allocation under state law, particularly in Western states. The 1977 amendments to the FWPCA were seemingly enacted to prevent permit programs from interfering with the states' right to allocate water and determine priority uses based on the appropriation doctrine, but the legislative history and language of the amendments has created ambiguity and widely differing interpretations of the intent of the legislation. It appears that new federal water pollution legislation does not allow for the traditional deference to state laws in allocating water resources. (Michael-PTT)
W87-05290

STATE AND FEDERAL ROLES UNDER THE CLEAN WATER ACT,
Environmental Protection Agency, Washington, DC.
C. T. Cherney, and K. M. Wardzinski.
Natural Resources and Environment, Vol. 1, No. 4, p 19-22, Winter 1986.

Descriptors: *Water law, *Clean Water Act, *State jurisdiction, *Federal jurisdiction, Permits, Environmental policy, Environmental management, Environmental Protection Agency, Regulations.

The Clean Water Act has created a comprehensive program to control water pollution by prohibiting any point source discharge to surface waters without a National Pollutant Discharge Elimination System (NPDES) permit. States may administer their own permit programs if the Environmental Protection Agency (EPA) approves them as meeting minimum standards of federal law and implementing regulations. The EPA maintains oversight responsibility of state programs that are found to comply with federal requirements. The EPA has focused its attention primarily on new state programs, and resource limitations have hampered its ability to review the adequacy of on-going programs. A reevaluation of existing programs has identified problems in the areas of adequacy and completeness of state legal authority to issue NPDES permits and effectively enforce against violations of those permits, backlogs in the issuance of permits and funding and staffing limitations of state NPDES programs. It is recommended that cooperation between the EPA and states be strengthened in order to improve the effectiveness of state-administered NPDES programs. (Michael-PTT)
W87-05291

FEDERAL ENVIRONMENTAL LAW AND STATE WATER LAW: ACCOMMODATION OR PREEMPTION,
Davis, Graham and Stubbs, Denver, CO.
G. J. Hobbs.
Natural Resources and Environment, Vol. 1, No. 4, p 23-26, 57-59. Winter 1986.

Descriptors: *Federal jurisdiction, *State jurisdiction, *Environmental policy, *Water law, Appropriation, Western states, Instream flow, Water rights, Water allocation, Endangered species, Water use, Environmental management, Colorado River.

Since 1977, the federal government has withdrawn from financing new water projects and has urged environmental interests to assert federal land management and environmental laws as a means to restrict the amount of water states may place to beneficial use. Critics of Western water law charge that Western states do not recognize instream flow as a beneficial use of water, but there are numerous examples where water rights administration and water projects produce environmentally beneficial instream flows throughout the West. A recent decision in the Riverside case that has national implications upheld the federal governmnt's right to require instream flow for which the U.S. had no water right, no means of assuring that released water would actually reach its intended use and no proof that flows would be beneficial to that use. A similar potential conflict has arisen in the Upper Colorado River Basin where three endangered fish species are the center of a controversy surrounding federal involvement in state water project decisions. The Riverside decision clearly calls for accommodation of federal environmental law and state water law. This can best be accomplished through the use of nonflow conservation alternatives and integrated state water administration which allocates and protects water rights for reasonable instream flow requirements as well as other uses. (Michael-PTT)
W87-05292

EPA VERSUS COLORADO: NATIONAL UNITY VERSUS STATE FLEXIBILITY,
T. Foster.
Natural Resources and Environment, Vol. 1, No. 4, p 27-30, 62, Winter 1986.

Descriptors: *Water law, *Environmental Protection Agency, *Colorado, *State jurisdiction, *Federal jurisdiction, Permits, Wastewater treatment, Water quality standards, Regulations.

When Colorado revised its Water Quality Control Act, the Environmental Protection Agency (EPA) reviewed the adequacy of its National Pollutant Discharge Elimination System (NPDES) permit program and uncovered a conflict between federal and state perspectives on how much flexibility from national standards is allowable for state peculiarities. The Colorado Act seemed to provide little flexibility to avoid translating stringent water quality criteria into expensive advanced wastewater treatment (AWT) requirements for municipal and industrial dischargers. At issue was whether the Colorado Water Quality Control Commission was prevented from acting in an appellate role in the NPDES permit issuance process, whether permit variances from effluent limitations were allowable which might deteriorate water quality standards and whether variance could be based on cost-benefit considerations. Colorado could not easily address EPA's concerns because it maintained that it needed program flexibility and had already revised classifications and standards for 52 chemical parameters for nearly every stream in the state. Colorado passed legislation in 1985 that partially resolved the conflict, but surrendered clear legal authority to provide formal variances from certain permit requirements based on economic considerations. Maintaining national uniformity at state expense may result in burdening the EPA with additional permit program implementation responsibilities. (Michael-PTT)
W87-05293

PRIVATE ENFORCEMENT OF THE CLEAN WATER ACT,
Environmental Protection Agency, Washington, DC.
C. M. Price.
Natural Resources and the Environment, Vol. 1, No. 4, p 31-33, 59-61, Winter 1986.

Descriptors: *Water law, *Public rights, *Clean Water Act, Regulations, Civil law, Environmental Protection Agency, Citizen suits, Public access.

The level of citizen enforcement has increased under the Clean Water Act for violations arising under the National Pollutant Discharge Elimination System (NPDES) program. The citizen suits provision authorizes any person with an interest that may be adversely affected to commence a civil action against a discharger that may be violating an effluent limit. Notice of the alleged violation must be given to the Environmental Protection Agency 60 days before commencing the action. Between 1978 and 1984, 236 citizen notices were received by EPA, and more than 60% of all citizen actions since 1978 have been brought under the Clean Water Act. Reasons for this high level of cases include persistent noncompliance, compilation and public availability of self-monitoring reports which contain evidence of violations and the availability of civil penalties. Citizen suits and the precedents established by them can affect government enforcement actions. Issues surrounding citizen suits include whether violations cited in monitoring reports are sufficient to support a plaintiff's motion for summary judgment in the issue of liability and the factors involved in assessing civil penalties. The extent to which private enforcement influences EPA's enforcement programs depends on agency resources. Although EPA's policy on specific citizen suit issues is still evolving, it continues to support efforts from any party which help ensure compliance with Clean Water Act requirements. (Michael-PTT)
W87-05294

ECONOMIC AND ENVIRONMENTAL PRINCIPLES AND GUIDELINES FOR WATER AND RELATED LAND RESOURCES IMPLEMENTATION STUDIES.
Water Resources Council, Washington, DC.
Government Printing Office, Washington, DC. March 10, 1983. 137 p, 15 fig, 43 tab, 2 append.

Descriptors: *Water resources development, *Standards, *Economic aspects, *Environment policy, Management planning, Federal jurisdiction, Cost analysis, Regulations, Public policy.

These economic and environmental principles and guide lines for water and related land resources implementation studies have been developed to guide the formulation and evaluation studies of the major Federal water resources development agencies. It contains the best currently available methods for calculating the benefits and costs of water resources development alternatives accurately and consistently, and is intended to ensure proper and consistent planning by the covered Federal agencies. These principles are established pursuant to the Water Resources Planning Act of 1965. (Ram-PTT)
W87-05324

PUBLIC RIGHTS OF NAVIGATION ON INLAND WATERWAYS,
Trent Polytechnic, Nottingham (England).
S. E. Foster.
Journal of Planning and Environment Law, p 336-339, May 1986 27 ref.

Descriptors: *Inland waterways, *Public rights, *Legal aspects, *Navigation, *Water law, *Public policy, *Property rights, *Judicial decisions, *Legal review, Waterways, Navigable rivers, Navigable waters, Rivers, Transportation, Legislation, Water policy.

Judicial decisions pertaining to Section 31(1) of the (British) Highways Act 1980 are reviewed. It is concluded that although there must be distinctions between rights of way over land and those over water, due to the intrinsic physical differences between those two elements, the same principles must apply to highways on water as to those over land. It is also suggested that the wording of Section 31 precludes its application to ways over water, as ways of such character that their use by the public prevents them giving rise to a common law presumption of dedication are thereby expressly excluded from the ambit of the section. (Author's abstract)
W87-05355

RESERVOIR SAFETY REFORMS,
University Coll. of Wales, Aberystwyth.
W. Howarth.
Journal of Planning and Environment Law, p 578-583, August 1986. 13 ref.

Descriptors: *Water law, *Legal aspects, *Reservoirs, *Safety, *Legislation, *Judicial decisions, *Public policy, *Dam failure, Standards, Water demand, Disasters, Flood control, Dam failure, Law enforcement, Administration, Administrative decisions.

The legal provisions governing the safety of reservoirs in England are reviewed and evaluated for adequacy. Included in the discussion are the Reservoirs (Safety Provisions) Act 1930, the Reservoirs Act 1975, and relevant judicial decisions. Shortcomings of the Reservoirs Act 1975 include: (1) the delay with which the Act has been brought into force; (2) the compromise of safety standards for simplicity of administration; and (3) the disproportionate cost that may be imposed upon those with ownership and control of a hazard. Nevertheless, it is concluded that the Act is of incalculable value in requiring those concerned with the administration and management of reservoirs and local authorities under which they fall to be constantly vigilant with respect to safety. (Author's abstract)
W87-05356

TOWARDS AN INTEGRATED APPROACH TO POLLUTION CONTROL: THE BEST PRACTICABLE EVNIRONMENTAL OPTIONS AND ITS ANTECEDENTS,
Durham Univ. (England).
For primary bibliographic entry see Field 5G.
W87-05357

SWIMMING UPSTREAM: FERC'S FAILURE TO PROTECT ANADROMOUS FISH,
F. L. Bodi, and E. Erdheim.
Ecology Law Quarterly, Vol. 13, No. 1, p 7-49, 1986. 294 ref.

Descriptors: *Water law, *Environmental protection, *Anadromous fish, *Federal Energy Regulatory Commission, *Administrative agencies, *Legal aspects, *Public policy, *Fish, Protection, Water pollution effects, Resources development, Water resources development, Decision making, Administrative decisions, Hydroelectric plants, Powerplants, State jurisdiction, Federal jurisdiction, Fisheries.

Anadromous fish conservation is seen to face an upstream struggle in decision making by the Federal Energy Regulatory Commission (FERC), for the following reasons: (1) Despite its statutory obligation to protect anadromous fish, FERC's priority is to approve hydroelectric applications even at the expense of fishery losses; (2) Despite staff limitations, FERC is unwilling to defer to the expertise of state and federal agencies and Indian tribes with treaty fishing rights; (3) FERC procedures do not promote full exploration of fishery issues, making it difficult for fishery agencies to participate meaningfully in the administrative process; (4) FERC has been reluctant to reform its practices even after courts explicitly reject its practices favoring power development. The net result of FERC's reluctance to comply with federal statutes is frequent litigation that ultimately serves the interests of neither hydropower developers nor fishery organizations. It is hoped that recent statutory revisions will provide the impetus for FERC to reform its practices and improve protection of anadromous fish. (Author's abstract)
W87-05358

ACID RAIN: STATES PROD EPA; ACID DEPOSITION STUDY,
W. A. Irwin.
Environmental Policy and Law, Vol. 15, No. 2, p

53-54-55, November 1985.

Descriptors: *Acid rain, *Legal aspects, *Jurisdiction, *Judicial decisions, *Environmental policy, *International law, *Chemistry of precipitation, Rainfall, Policy making, Protection, Environmental protection, State jurisdiction.

Six states have petitioned the U.S. Environmental Protection Agency (EPA) and subsequently brought court action to compel the EPA to enforce ambient air quality standards. The U.S. District Court for the District of Columbia has ordered EPA to set in motion processes to prevent or eliminate endangerments resulting from the subject violations of the Clean Air Act, including a determination of reciprocity of legal rights between the United States and Canada. Canadian Environment Minister Fred Bradley announced in September 1985 that the government of Alberta plans to spend up to $4.8 million on existing projects during 1985-88 as its share of the recently announced $9.5 million research program to study acid deposition funded jointly by the governments of the four western provinces, the Northwest Territories, and the federal government. (Doria-PTT)
W87-05359

ROLE OF STATUTE LAW IN ENVIRONMENTAL MANAGEMENT: A CASE STUDY OF WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
M. Hollick.
Environmental and Planning Law Journal, Vol. 2, No. 2, p 116-130, June 1985.

Descriptors: *Water law, *Environmental management, *Case studies, *Australia, *Legal aspects, *Legislation, *Political constraints, *Administration, Administrative agencies, Public policy, Policy making, Decision making, Jurisdiction, Land use, Planning, Rural areas, Conservation.

The various influences that mold the shape of environmental legislation and determine its effectiveness in practice are reviewed with particular reference to Western Australia. Political considerations, weaknesses in drafting, and internal and external influences on the administering authorities are shown to combine to produce a framework for environmental management that may bear little resemblance to the intentions of Parliament or the expectations of the community at the time the legislation was introduced. Suggestions for reform are presented. (Author's abstract)
W87-05360

GREAT LAKES DIVERSION AND CONSUMPTIVE USE: THE ISSUE IN PERSPECTIVE,
Center for the Great Lakes, Chicago, IL.
For primary bibliographic entry see Field 4A.
W87-05361

GREAT LAKES CHARTER: TOWARD A BASINWIDE STRATEGY FOR MANAGING THE GREAT LAKES,
Wisconsin Dept. of Administration, Madison.
P. V. MacAvoy.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 49-65, Winter 1986. 60 ref.

Descriptors: *Water law, *Great Lakes, *Water management, *Legal aspects, *Water resources development, *Policy making, *Regional planning, Water supply development, Public policy, Water policy, Economic aspects, Social aspects, Water supply, Decision making, Regional development, Planning.

The Great Lakes Charter is an agreement among Great Lakes states and provinces detailing cooperative actions to ensure a sufficient, reliable supply of clean Great Lakes water for the region. This paper summarizes the development of the Charter and its role in stimulating and guiding the evolution of a regional water management framework. Policy makers, resource managers, researchers, and citizens recognize the need for an integrated course of action to balance and protect the interests of those in the region who depend on the water resources of the basin and to prevent the degradation of the quality and quantity of those resources. The Charter is especially meaningful because of its emphasis on a specific program of implementation, rather than offering only sweeping policy statements. The biggest challenge currently facing the region is to maintain the momentum toward development of the Charter's integrated management strategy; mutual cooperation and good faith will continue to be essential ingredients in the process. (Author's abstract)
W87-05362

INTER AND INTRASTATE USAGE OF GREAT LAKES WATERS: A LEGAL OVERVIEW,
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 67-108, Winter 1986. 140 ref.

Descriptors: *Water law, *Legal aspects, *Great Lakes, *Water use, *Water management, *Regional planning, *Diversion, *Legal review, Planning, Routing, Irrigation, Jurisdiction, Adjudication procedure, Common law, Legislation, Judicial decisions, Riparian rights, Public policy, Water policy, Groundwater, Constitutional law, Regulations, Federal jurisdiction.

The legal strategies available to the Great Lakes Basin states to chart the future use of the Great Lakes is reviewed. The decision in Sporhase v. Nebraska and the possibility of federal intervention in the allocation of interstate waters deprives the states of the exclusive authority to decide who can have access to the lakes for consumptive withdrawals. The littoral states and the Canadian provinces must unite to develop a common management strategy. The article provides a starting point for development of this strategy, describes the federal constraints that state regulatory legislation may face, and describes five options open to the states to conserve basin waters in a manner consistent with federal law. The latter include export embargoes, even-handed use restrictions, equitable apportionment actions, interstate compacts, and comprehensive management legislation. The approval of the Great Lakes Charter is the first step in the process. (Doria-PTT)
W87-05363

OVERVIEW OF CANADIAN LAW AND POLICY GOVERNING GREAT LAKES WATER QUANTITY MANAGEMENT,
Canadian Environmental Law Research Foundation, Toronto (Ontario).
M. Valiante, P. Muldoon, J. Harvey, P. King, and P. Emond.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 109-153, Winter 1986. 211 ref.

Descriptors: *Water law, *Canada, *Legal aspects, *Water policy, *Great Lakes, *Water supply, *Regional planning, *Diversion, *Legal review, Planning, Routing, Legislation, Regulations, Water use, Consumptive use, Federal jurisdiction, Jurisdiction, Policy making, Civil law, Common law, Riparian rights, Groundwater, Ownership of beds, Trespass, Judicial decisions, Permits, Nuisance.

An overview is provided of the legal regimes in Canada governing water quantity management, with an emphasis on how these regimes might respond to a proposed diversion of water from or into the Great Lakes Basin. The laws and policies of the Canadian government and the provinces of Quebec and Ontario are examined. Topics addressed include common and civil law, riparian rights, ownership of beds, private and public nuisance and trespass, the public trust doctrine, proprietary rights, and jurisdiction. (Doria-PTT)
W87-05364

PUBLIC INTERNATIONAL LAW AND WATER QUANTITY MANAGEMENT IN A COMMON DRAINAGE BASIN: THE GREAT LAKES,
S. A. Williams.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 155-201, Winter 1986. 227 ref.

Descriptors: *Water law, *Legal aspects, *Water management, *Water supply, *International law, *Catchment areas, *Great Lakes, *Water policy, *Legal review, State jurisdiction, Judicial decisions, Riparian rights, Canada, United States, Treaties, Adjudication procedure.

There is a potential confrontation between the western 'water poor' states and the 'water rich' states of the Great Lakes region over the issue of diversion. The following are analyzed: (1) the impact of the Boundary Waters Treaty of 1909 on protection of water quantity in the Great Lakes Basin; (2) the fundamental rules of international law relevant to disputes arising between Canada and the United States concerning diversions out of the basin in violation of that treaty if Canada seeks to divert into the basin; (3) the global international environmental law rules bearing on the issue; and (4) the options available on the international level for the states and provinces located in the basin. (Author's abstract)
W87-05365

LAKE DIVERSION AT CHICAGO,
Illinois State Dept. of Transportation, Chicago. Div. of Water Resources.
B. Barker.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 203-218, Winter 1986. 59 ref, append.

Descriptors: *Water law, *Lakes, *Diversion, *Chicago, *Legal aspects, *Great Lakes, *Lake Michigan, Routing, Navigable waters, Adjudication procedure, Water supply, Water management, Resource allocation, Judicial decisions.

Diversion of Lake Michigan water to the Mississippi River watershed of Chicago, the largest out-of-basin transfer from the Great Lakes, has become limited as a result of legal action. This article describes lake diversion at Chicago in physical and operational terms as it now exists under the controlling decrees; presents the historical development of the diversion and the resulting legal disputes, emphasizing the balancing role of the state in developing a navigable waterway while attempting simultaneously to protect Chicago's water supply; and summarizes the legal standing of lake diversion at Chicago. (Author's abstract)
W87-05366

MODEL STATE WATER ACT FOR GREAT LAKES MANAGEMENT: EXPLANATION AND TEXT,
Michigan Univ., Ann Arbor.
J. L. Sax.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 219-238, Winter 1986. 60 ref.

Descriptors: *Water law, *Legal aspects, *Legislation, *Great Lakes, *Water management, *State jurisdiction, Selective withdrawal, Regional planning, Planning, Regulations, Water supply, Law enforcement, Adjudication procedure.

The enactment of parallel legislation by the various jurisdictions involved in Great Lakes Basin management is recommended as the first step in recognizing the mutual interests and responsibilities of the states and provinces in protecting the basin. The minimum purposes of such legislation are development of information about new uses of water, agreement to cooperate with other states in permitting uses, and regulation of major diversions through notification and permitting. A Model State Water Act is presented to provide the structure for a common legislative approach, drafted to follow as closely as possible a law already enacted by Wisconsin. The discussion includes an explanation of the purpose and general coverage of the model act, a detailed analysis of its provisions, and the text of the model act itself. (Author's abstract)
W87-05367

BINDING TIES, TYING BONDS: INTERNATIONAL OPTIONS FOR CONSTRAINTS ON GREAT LAKES DIVERSIONS,
R. J. Sugarman.
Case Western Reserve Journal of International Law, Vol. 18, No. 1, p 239-259, Winter 1986. 44 ref.

Descriptors: *Water law, *Legal aspects, *Treaties, *International law, *Great Lakes, *Water policy, *Diversion, *Regional planning, Routing, Consumptive use, Water use, Planning, Water demand, Water management, Decision making, Policy making, Land use, Economic aspects, Social aspects, Constitutional law, Judicial decisions.

The need and options for modified international undertakings are discussed to enhance the protection afforded the Great Lakes against diversion of water. It is concluded that Canada and the United States can, legally and practically, substantially increase the difficulty of effecting a diversion from the Great Lakes or their tributaries through enhanced treaty protections. The existing treaty has established a record of effectiveness and consistency, and there could well be substantial support in both the U.S. Congress and Canada for such additional protection. (Author's abstract)
W87-05368

WATER SUPPLY IN ANIMAL HUSBANDRY FROM MUNICIPAL SOURCES-SITUATION, STANDARDS, LEGAL FUNDAMENTALS, PROBLEMS (TRANK- UND BRAUCHWASSER AUS DER OFFENTLICHEN WASSERVERSORGUNG: SITUATION, STANDARDS, RECHTLICHE GRUNDLAGEN, PROBLEME),
Niedersaechsisches Ministerium fuer Ernaehrung, Landwirtschaft und Forsten, Hanover (Germany, F.R.).
J. Muller.
Deutsche Tierarztliche Wochenschrift, Vol. 93, No. 7, p 305-307, July 23, 1986. 3 fig, 2 tab.

Descriptors: *Water supply, *Livestock, *Municipal water, *Legal aspects, *Standards, *Water quality, Water quality management.

The status of the municipal water supply in Lower Saxonia is reported using actual figures on the quantities of water acquisition and delivery as well as the extent of supply. The judicial assessment of an enforced supply and use is also outlined. The essential regulations in municipal water supply are explained. Problems are pointed out in the field of protection of waters, which have to be solved to ensure sufficient water supply, and possible answers to manage these problems are indicated. (Author's abstract)
W87-05375

EVALUATION OF POLLUTION CONTROL LEGISLATION IN INDIA,
For primary bibliographic entry see Field 5G.
W87-05378

EQUITABLE APPORTIONMENT: THE SUPREME COURT PARTS THE WATERS,
C. H. Eccles.
Utah Law Review, No. 2, p 399-416, 1986. 117 ref.

Descriptors: *Legal aspects, *Property rights, *Appropriation, *Judicial decisions, *Water law, *Water rights, *Supreme Court, Regulations, Waterways, Conservation, Public policy, Policy making, Decision making, Economic aspects, Water use, Cost-benefit analysis.

In Colorado v. New Mexico, the Supreme Court has refined the test for achieving an equitable apportionment by balancing the factors articulated in prior cases. Changes made in the doctrine by this new decision include: (1) an emphasis on conservation; (2) an explicit willingness to consider proposed diversions, even at the expense of existing users; and (3) a new evidentiary standard that must be met by the state seeking the proposed diversion. The Court will continue to place the initial burden of proof on the petitioning state to prove real or substantial injury. Once this standard is met, however, the burden will shift to the other state to show reasonable conservation measures that could be taken and that the benefits from the proposed diversion outweigh the harms. It is concluded that, while Colorado v. New Mexico does not substantially change the theory of equitable apportionment, it does continue the doctrine's evolutionary development while providing a clearer perspective on the Court's current attitude toward apportionment. (Author's abstract)
W87-05379

PLAYING THE ACID RAIN GAME: A STATE'S REMEDIES,
R. J. R. Smith.
Environmental Law, Vol. 16, No. 2, p 255-317, Winter 1986. 254 ref.

Descriptors: *Water law, *Acid rain, *Air pollution control, *Legal aspects, *State jurisdiction, *Regulations, *Legislation, Pollutants, Sulfur dioxide, Sulfates, Nitrogen oxides, Nitrates, Hydrocarbons, Air pollution effects, Rainfall, Policy making, Decision making, Case studies, Judicial decisions, Common law, Public policy.

States have attempted to use a variety of methods to control acid rain. These methods include the Clean Air Act, federal and state common law nuisance actions, individual state regulations, and interstate compacts. The control alternatives that have been used are reviewed, showing how ineffective these alternatives have proven to be. The conclusion calls for comprehensive control legislation, outlines the elements that an effective control program must include, and proposes a legislative solution. (Author's abstract)
W87-05380

LEGAL INCENTIVES FOR REDUCTION, REUSE, AND RECYCLING: A NEW APPROACH TO HAZARDOUS WASTE MANAGEMENT,
R. G. Gordon.
The Yale Law Journal, Vol. 95, No. 4, p 810-831, March 1986. 129 ref.

Descriptors: *Water law, *Waste disposal, *Recycling, *Waste recovery, *Waste management, *Legal aspects, *Legislation, *Regulations, Planning, Research priorities, Administration, Administrative agencies, Law enforcement.

The inadequacy of current approaches for managing hazardous waste is reviewed, and a model legislative package is proposed based on reduction, reuse, and recycling. Topics covered include the current emphasis on waste production and disposal, problems with the current approach, the benefits of reduction, reuse, and recycling, setting goals and overcoming obstacles to source reduction legislation, ambiguous regulatory programs and priorities, feasibility questions, information deficiencies, industry opposition, planning, research, institutional assistance, statutory and regulatory adjustments, and implementation. (Doria-PTT)
W87-05381

STATE AND FEDERAL LAND USE REGULATION: AN APPLICATION TO GROUNDWATER AND NONPOINT SOURCE POLLUTION CONTROL,
For primary bibliographic entry see Field 5G.
W87-05382

EMERGENCY WATER PLANNING PROGRAM,
Louisiana Dept. of Health and Human Resources, New Orleans.
F. Hull, and T. J. Ray.
Southwest and Texas Water Works Journal, Vol. 168, No. 8, p 5, November 1986.

Descriptors: *Planning, *Emergency planning, *Water management, *Surveys, *Administrative agencies, *Water supply, Resources management, Water use, Computers, Public health.

The U.S. Army Corps of Engineers has been directed by the President of the United States to take the leadership role in the development, coordination, and implementation of an emergency water plan. The plan being developed will describe in detail the water management responsibilities, procedures, and actions of the Corps and other federal, state, and local agencies for various types of water emergencies. The Corps' New Orleans District is responsible for developing the plan for the state of Louisiana. An important component of the plan is a statewide inventory of water and wastewater systems. To fill data gaps and to update water use data available to the state, a water use survey is being developed jointly by the Corps and the Louisiana Department of Health and Human Resources. Participation is urged, since it is the most important ingredient for assuring that public water systems continue to serve safe drinking water during emergencies. (Author's abstract)
W87-05383

WATER CHEMISTRY IN CHANGING TIMES: SIXTY YEARS OF THE WATER CHEMISTRY DIVISION OF THE GERMAN CHEMICAL SOCIETY (WASSERCHEMIE IM WANDEL DER ZEITEN: 60 JAHRE FACHGRUPPE WASSERCHEMIE IN DER GESELLSCHAFT DEUTSCHER CHEMIKER),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
For primary bibliographic entry see Field 2K.
W87-05454

ENGINEERING AND LEGAL RAMIFICATIONS OF GROUNDWATER CONTAMINATION - A CASE STUDY,
Dufresne-Henry, Inc., Concord, MA.
For primary bibliographic entry see Field 5G.
W87-05559

NATIONAL ENVIRONMENTAL POLICIES AND RESEARCH PROGRAMS: A COMPARISON AMONG SELECTED COUNTRIES.
MITRE Corp., McLean, VA.
For primary bibliographic entry see Field 5G.
W87-05715

POLITICAL SCIENCE RESEARCH ON FLOOD MITIGATION,
Colorado State Univ., Fort Collins. Dept. of Political Science.
H. P. Caulfield Jr.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 137-153, 7 ref.

Descriptors: *Political aspects, *Political constraints, *Legal aspects, *Flood control, Policy making, Flood plain zoning, Flood plain management, Flood insurance, Public policy, Project planning, Risks, Local governments, Flood damage, Planning, Social aspects, Regulations, Research priorities.

The knowledge derived from research by political scientists is pertinent to improved governmental action with respect to flood mitigation. Three types of political science research (together with interdisciplinary research proposals) are proposed as an initial program: political behavioral, policy analysis (formulation/legitimation, implementation and impact) and intergovernmental research. Interdisciplinary research involves work on flood insurance rates, performance standards for local governments, flood mitigation and social goals, and risk-benefit analysis. Research problems deemed to be critically important include catastrophe and political action, pre-flood planning and post-flood measures, local community responsibility, new federalism and flood mitigation, and flood mitigation management and scarce resources. The knowledge gained from this proposed program of research could be useful in advancing the effectiveness, equity and efficiency of current practices of flood mitigation. (See also W87-05717) (Geiger-PTT)

W87-05723

LEGAL ASPECTS OF MITIGATING FLOOD DAMAGES,
American Bar Foundation, Chicago, IL.
W. A. Thomas.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 157-170, 8 ref.

Descriptors: *Legal aspects, *Flood control, *Flood damage, *Flood plain management, *Flood protection, Research priorities, Flood plain zoning, Flood forecasting, Water law, Legislation, Flood routing, Coastal zone management, Public health, Public rights, Flood insurance.

Recommendations for legal research concerning flood mitigation are made with particular reference to three major national themes: the National Flood Insurance Program and related emergency measures, the trend from structural to non-structural mitigation measures, and the emergence of involvement by local communities in mitigation planning. A survey of legal issues is given covering the areas of preparedness/mitigation, flood warning, emergency response, and recovery/restoration. Five high priority research recommendations are identified: tax policies of federal and state governments should be reviewed to encourage construction of flood-control structures and buildings designed to withstand flooding; empirical surveys should be made of the success rates of different law enforcement procedures regarding restrictions on uses of flood plains; studies should be undertaken on the legal ramifications of limitations on reconstruction after flooding; investigations should be made as to whether liability exists for issuing flood warnings; and conflicts between local and federal mappings for flood zoning and related land-use purposes should be resolved. (See also W87-05716) (Geiger-PTT)
W87-05724

6F. Nonstructural Alternatives

SALINITY IN WATERCOURSES AND RESERVOIRS.
For primary bibliographic entry see Field 5G.
W87-05165

OPERATIONAL FLOOD WARNING SYSTEM,
For primary bibliographic entry see Field 4A.
W87-05562

PLAN FOR RESEARCH ON FLOODS AND THEIR MITIGATION IN THE UNITED STATES,
Illinois State Water Survey Div., Champeign.
For primary bibliographic entry see Field 4A.
W87-05716

RESEARCH PROBLEMS IN HYDROLOGY AND HYDRAULICS,
For primary bibliographic entry see Field 2E.
W87-05718

AGENDA FOR ECONOMIC RESEARCH ON FLOOD HAZARD MITIGATION,
Florida Univ., Gainesville. Dept. of Economics.
For primary bibliographic entry see Field 2E.
W87-05721

POLITICAL SCIENCE RESEARCH ON FLOOD MITIGATION,
Colorado State Univ., Fort Collins. Dept. of Political Science.
For primary bibliographic entry see Field 6E.
W87-05723

LEGAL ASPECTS OF MITIGATING FLOOD DAMAGES,
American Bar Foundation, Chicago, IL.
For primary bibliographic entry see Field 6E.
W87-05724

6G. Ecologic Impact Of Water Development

FISH AND WILDLIFE MITIGATION PROGRAM FOR THE COLORADO RIVER BASIN SALINITY CONTROL PROJECT - A CASE HISTORY,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
T. A. Burke, D. E. Busch, and W. E. Rinne.
IN: Salinity in Watercourses and Reservoirs. Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity, July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston, Massachusetts. 1984. p 539-548, 1 tab, 2 ref.

Descriptors: *Fish conservation, *Mitigation, *Colorado River, *Ecological effects, *Management planning, Case histories, Environmental effects, Environmental impact statement, Fish management, Fish, Water resources development.

Title I of the Colorado River Basin Salinity Control Project specifically provides for measures necessary to control salinity of the Colorado River below Imperial Dam. Environmental analyses of the Title I Project were presented in the Final Environmental Impact States (EIS) filed by the Burea of Reclamation on June 10, 1975. The EIS made an in-depth determination of the salinity control project's impacts, both adverse and beneficial. While the EIS discussed the types and relative amounts of environmental imapcts, definite plans for their mitigation were not developed until after the EIS was finalized. Some of the project's adverse impacts were avoided prior to development of an actual mitigation plan by simply incorporating measures into both the project design and the construction schedules. Some of these measures were: using the existing main outlet drain as a conveyance channel for salt water wastes; screening the feed water intake to the desalting plant to reduce fish losses; conducting fish salvage during canal dewatering works; and providing bridges, siphons, and escape ladders in and along the canals for both human and wildlife use. Two separate fish and wildlife Ad Hoc Committees were formed to develop the mitigation plans for this project. One committe was responsible for mitigation of adverse impacts associated with the concrete-lined canal in California, and the other Ad Hoc Committee dealt with the effects from the desalting plant and the protective and regulatory pumping. Both committees were to remain in effect until mitigation concepts were thoroughly planned, designed, and implemented. In total, eleven accepted recommended proposals were expected to recover 67.5% of the fish and wildlife losses expected to result from the Title I Salinity Control Project. The most significant facet of the mitigatino process yet to be completed is the evaluation of the effectiveness of the implemented mitigation measures. (See also W87-05165) (Lantz-PTT)
W87-05215

HYDROELECTRIC OPERATION AT THE RIVER BASIN LEVEL: RESEARCH NEEDS TO INCLUDE ECOLOGICAL ISSUES IN BASIN-LEVEL HYDROPOWER PLANNING.
Oak Ridge National Lab., TN.
Proceedings of a Workshop held by the Electric Power Research Institute, September 16-17, 1981, Oak Ridge, Tennessee. EPRI Report WS-80-155, Electric Power Research Institute, Palo Alto, CA. June 1981. 42 p.

Descriptors: *Hydroelectric power, *Ecology, *Hydropower, *Reservoir management.

A workshop to recommend research needed to quantitatively integrate ecological issues in river basin level hydropower planning was held in Oak Ridge, Tennessee, on September 15-17, 1980. The 32 workshop participants identified 18 research topics that were responsive to the workshop objective. These topics were related to impacts of water level fluctuations, instream flow requirements, water quality alteration, and impacts on migratory fish. The development of these research topics and recommended research prorities are summarized in this report. (Author's abstract)
W87-05250

HISTORIC RESOURCES RELATED TO CONSTRUCTION ACTIVITIES AT ELEPHANT BUTTE RESERVOIR.
Bureau of Reclamation, Amarillo, TX. Southwest Region.
August 1986. 159 p, 18 fig, 3 tab, 37 ref, 2 append.

Descriptors: *History, *Elephant Butte Reservoir, *Construction, *Archeology, *Dam construction, Reservoir construction, Dams, Dikes, Reservoirs, Site selection.

The original construction of the Elephant Butte Reservoir was completed in 1916. Construction of additional facilities associated with the reservoir has been carried on intermittently since that time with much activity during the depression era. Recent Bureau of Reclamation cultural resource investigations have concentrated on the historic resources which relate to these early construction activities. This report takes an inventory of historic construction related sites, briefly reviews the historic construction activities and related sites at Elephant Butte Reservoir, discusses recent cultural resource investigations of construction related sites, and presents some management recommendations to aid in recognizing resources which might be altered by modern operation and maintenance activities. (Author's abstract)
W87-05323

CHANAGES IN ALLUVIAL DEPOSITS, UPPER GRAND CANYON,
Geological Survey, Tucson, AZ.
For primary bibliographic entry see Field 2J.
W87-05755

GEOMORPHIC - HYDRAULIC SIMULATION OF CHANNEL EVOLUTION,
Water Engineering and Technology, Inc., Shreveport, LA.
For primary bibliographic entry see Field 2J.
W87-05794

CHANNEL WIDTH ADJUSTMENT IN STRAIGHT ALLUVIAL STREAMS,
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W87-05795

PREDICTING CHANNEL ADJUSTMENT TO CHANNELIZATION,
Colorado State Univ., Fort Collins. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W87-05796

SIMILARITY OF BANK PROBLEMS ON DISSIMILAR STREAMS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W87-05797

SEDIMENT STUDIES IN GRAND CANYON, ARIZONA,
Geological Survey, Tucson, AZ.
For primary bibliographic entry see Field 2J.
W87-05798

CHANNEL EVOLUTION IN MODIFIED TENNESSEE CHANNELS,
Geological Survey, Nashville, TN.
For primary bibliographic entry see Field 4A.
W87-05799

VEGETATION AND BANK-SLOPE DEVELOPMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4A.
W87-05800

EVOLUTION OF TWO DREDGED CHANNELS IN OKLAHOMA,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 4A.
W87-05801

DEVELOPMENT AND APPLICATION OF A SEDIMENTATION MODELING SYSTEM,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2J.
W87-05817

BUDGET ANALYSIS OF TURBIDITY AND STREAMFLOW DATA,
Umpqua National Forest, Roseburg, OR.
K. Smith.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 407-415, 8 fig, 3 tab, 5 ref.

Descriptors: *Water quality, *Turbidity, *Stream flow, *Data aquisition, *Layng Creek, *Oregon, Watersheds, Water quality control, Model studies, Sediment transport, Monitoring.

Turbidity and streamflow data collected from an 8-yr USDA-Forest Service monitoring project on Layng Creek, a 60 sq mi Western Oregon watershed with high timber and water supply values, was analyzed to provide an indication of the turbidity production response of the watershed. A sediment budget model was used to quantify various production components which, in turn, were examined to determine relative quantities and annual trends. This study also showed deficiencies in the data which can be eliminated in future monitoring. (See also W87-05791) (Author's abstract)
W87-05833

SPATIAL AND TEMPORAL CHANGES IN LOUISIANA'S BARATARIA BASIN MARSHES, 1945-1980,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W87-05876

7. RESOURCES DATA

7A. Network Design

ANALYSIS OF RESEARCH NEEDS CONCERNING THE TREATMENT, UTILIZATION, AND DISPOSAL OF WASTEWATER TREATMENT PLANT SLUDGES.
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5E.
W87-05325

RESEARCH NEEDS ASSOCIATED WITH TOXIC SUBSTANCES IN WASTEWATER TREATMENT SYSTEMS.
Water Pollution Control Federation, Washington, DC.
For primary bibliographic entry see Field 5D.
W87-05335

METEOROLOGICAL RESEARCH NEEDS ON FLOODS AND THEIR MITIGATION,
Maryland Univ., College Park. Inst. for Physical Science and Technology.
H. E. Landsberg.
IN: A Plan for Research on Floods and Their Mitigation in the United States, Illinois State Water Survey Div., Champaign, Illinois. p 23-38, 1 fig, 48 ref.

Descriptors: *Flood forecasting, *Flood control, *Flood data, *Flood profiles, *Meteorological data collections, Flood protection, Flooding, Flood plain management, Hydrologic data collections, Weather data collections, Probable maximum precipitation, Remote sensing, Prediction.

The principal contribution that meteorology can make in mitigating the effects of flood is in the issuance of timely warnings. The current status of observations and predictions of weather events that can lead to coastal and riverine flooding are reviewed. New avenues for research in weather observation systems, forecasting, spring flood prediction, maximum probable precipitation predictions, and communications about flood events are discussed. Six recommendations are made for further research: improved quantitative remote sensing of precipitation for integration with conventional raingage networks; specific effort to produce reliable quantitative precipitation predictions for large amounts, including the development of numerical mesoscale models for this purpose; imporved prediction of tropical storm systems close to shore and inland with particular emphasis on improving the 36-48 hr forecast; examination and study snow pack release as a major contributor to flood conditions; re-examination of statistical procedures for estimating maximal rainfall values for different time intervals and space dimensions; and re-analysis of historical cases of floods, including flash floods, the synoptic patterns which caused them, and the effect of antecedent precipitation. (See also W87-05716) (Geiger-PTT)
W87-05717

METHODOLOGICAL BASIS OF WORLD WATER BALANCE INVESTIGATION AND COMPUTATION,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 2A.
W87-05733

SMALL WATERSHED MODEL (SWAM),
Science and Education Administration, Fort Collins, CO.
E. H. Seely, C. V. Alonso, and D. G. DeCoursey.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume II, 1986. p 321-324, 9 ref.

Descriptors: *Watersheds, *Model studies, *Simulation analysis, Flow profiles, Sediment transport, Path of pollutants, Water pollution sources, Groundwater, Land use, Management planning.

The Small Watershed Model (SWAM) is a state-of-the-art model that simulates the movement of water, sediment, and chemicals through a small, mixed-land-use watershed. It was developed to aid planners and others in assessing nonpoint sources of pollution. To the maximum extent practical, the physical processes are simulated using causal rather than black-box approaches. The watershed is divided into source are, channel, reservoirs, and groundwater segments within which water, sediment and chemicals move, interacting with each other and with the agricultural environment. Agricultural land use and management pratices as well as daily changes in vegetative cover and infiltration rates are simulated in source areas, and the state of other model variables are simulated throughout the catchment system. (See also W87-05791) (Author's abstract)
W87-05824

7B. Data Acquisition

SALINITY BALANCE OF THE LOWER VIRGIN RIVER BASIN, NEVADA AND ARIZONA,
Montana Univ., Missoula. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W87-05178

MEEKER DOME SALINITY INVESTIGATION,
CH2M/Hill, Denver, CO.
For primary bibliographic entry see Field 5B.
W87-05198

TWO-WELL RECIRCULATION TRACER TESTS AT THE H-2 HYDROPAD, WASTE ISOLATION PILOT PLANT (WIPP), SOUTHEASTERN NEW MEXICO.
Hydro Geo Chem, Inc., Tucson, AZ.
For primary bibliographic entry see Field 5B.
W87-05254

EFFECT OF SURFACE PROPERTIES ON THE NARROW TO BROADBAND SPECTRAL RELATIONSHIP IN CLEAR SKY SATELLITE OBSERVATIONS,
Maryland Univ., College Park. Dept. of Meteorology.
R. T. Pinker, and J. A. Ewing.
Remote Sensing of Environment RSEEA7, Vol. 20, No. 3, p 267-282, December 1986. 10 fig, 3 tab, 16 ref. NOAA Grant NA84AA-H-00026.

Descriptors: *Mathematical studies, *Spectral analysis, *Satellite technology, *Albedo, *Atmospheric physics, *Remote sensing, *Simulation analysis, Atmosphere, Simulation, Model studies, Radiation, Mathematical analysis.

Several computational experiments were conducted to estimate the difference between clear sky spectral narrowband and broadband planetary albedo for three cases of wavelength-independent surface albedo and four cases of surface wavelength-dependent albedo (snow, dry sand, meadow, water). The spectral interval of 0.5-0.7 micron was selected to approximate the bulk of the VISSR visible channel on the GOES satellites and Channel 1 of the AVHRR on the NOAA operational satellites. Different atmospheric conditions and solar zenith angles were simulated. It was demonstrated that the relationship between the spectral narrowband and broadband planetary albedo depends primarily on the assumptions made about the magnitude and wavelength dependence of the surface albedo and less on the atmospheric conditions. Future attempts to parametrize the conversion from narrowband to broadband spectral observations should account for the surface type. (Author's abstract)
W87-05346

CLOUD CLIMATOLOGY FOR THE SOUTH ATLANTIC DERIVED FROM METEOSAT I IMAGES,
Hamburg Univ. (Germany, F.R.). Meteorology Inst.
S. Coulmann, S. Bakan, and H. Hinzpeter.
Tellus TELLAL, Vol. 38A, No. 5, p 453-461, October 1986. 6 fig, 16 ref.

Descriptors: *Meteorology, *Remote sensing, *METEOSAT I, *Cloud climatology, *South Atlantic, *Statistics, *Climatology, Boundary layers, Clouds, Jet stream, Seasonal variation.

Clouds play a major role for the radiation balance of the planet, which itself is the most important process that drives the climate system. Incoming solar as well as emitted terrestrial radiation is strongly influenced by emission, absorption and scattering of radiation by clouds. As a basis for climate studies and modelling, a knowledge of temporal and spatial distribution of clouds is most important. Progress towards understanding the earth's climate is currently hindered by the limited knowledge of the global cloud distribution and its variability. There is at present no unique and generally agreed global cloud climatology. Statistics of total and high-level cloud amount (monthly average and standard deviations) over 5 deg x 5 deg areas have been derived for the South Atlantic between 0 - 40 deg S and 10 deg E-35 deg W from METEOSAT I data. Glossy prints of all available noon images between February 1978 and November 1979 were evaluated with a threshold method using the VIS and IR data. The main features of the cloudiness over the South Atlantic are the

highly persistent boundary layer cloudiness in the eastern regions, the high cloud coverage in connection with the subtropical jet stream and the relatively low cloud coverage in the western regions. The cloudiness in the eastern regions undergoes a clear seasonal cycle with maximum cloud amounts during September-November and minimum in June, while in the other regions, the seasonal cycle is less evident. A remarkable amount of high level cloud was found during all months in connection with the subtropical jet stream, and between December and May near the coasts. (Alexander-PTT)
W87-05404

FIELD EVIDENCE FOR A BI-POROUS SOIL WATER REGIME IN CLAY SOILS,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental Unit.
For primary bibliographic entry see Field 2G.
W87-05448

ALGAE FLUORESCENCE AUTOMETER, A COMPUTERIZED BIOASSAY (ALGENFLUORESZENZ-AUTOMETER, EINE COMPUTERGESTEUERTE BIOTEST-MESSAPPARATUR),
F. Sayk, and C. Schmidt.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 19, No. 5, p 182-184, October 1986. 4 fig, 2 tab, 4 ref.

Descriptors: *Measuring instruments, *Algae, *Bioassay, *Computers, *Fluorescence, Pollutants, Chemical interference, Contamination, Water pollution, Water quality.

A measuring device is described which, in combination with a personal computer, allows an automated performance of an algae bioassay. The test is based on the measurement of the influence of chemicals or contaminated water on algal fluorescence. (Author's abstract)
W87-05461

SIMPLE DETERMINATION OF VOLATILE HALOGENATED OR AROMATIC HYDROCARBONS IN SOIL AND SLUDGE SAMPLES BY HEAD SPACE GAS-CHROMATOGRAPHY (EINFACHE BESTIMMUNG LEICHTFLUCHTIGER HALOGENIERTER ODER AROMATISCHER KOHLENWASSERSTOFFE IN BODEN- UND SCHLAMMPROBEN DURCH DAMPFRAUM-GAS-CHROMATOGRAPHIE),
For primary bibliographic entry see Field 5A.
W87-05474

SYSTEM FOR MEASURING INFILTRATION RATES UNDER CENTER-PIVOT IRRIGATION SYSTEMS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W87-05536

EUROPEAN WEATHER RADAR: A TOOL FOR UK WATER RESOURCES MANAGEMENT,
D. H. Newsome.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 40, No. 5, p 415-427, October 1986. 6 fig, 2 tab, 17 ref.

Descriptors: *Rainfall, *Precipitation, *Water resouces management, *Remote sensing, *Measuring instruments, *Weather data collection, *Weather forecasting, *Europe, *Radar, United Kingdom, Interagency cooperation, Weather satellites.

The European weather radar network being developed under European Cooperation in Science and Technical Research (COST) project 72 has as primary users public water authorities responsible for meteorological and water services. Forecasts would be expected to include information about: expected time of onset and cessation of precipitation,; the expected intensity pattern of the precipitation event, and the expected amount of precipitation for defined areas over specified time periods. The operational structure of the weather radar system in the United Kingdom and results of its use are described. A single radar, when used with a suitable computer, is a powerful and flexible tool for the quantitative measurement of precipitation over catchments, sub-catchments, and outcrops of aquifers in real time. When the single radar is integrated into a network and its output combined with data from meteorological satellites, its utility is further enhanced. (Rochester-PTT)
W87-05560

RAIN - THE RAW MATERIAL: WAYS TO MEASURE, MODEL AND MANAGE IT,
Department of Housing and Urban Development, Washington, DC.
For primary bibliographic entry see Field 2B.
W87-05561

AUTOMATION OF AN ELECTROLYTIC CELL FOR THE TREATMENT OF OILY WASTEWATER,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
For primary bibliographic entry see Field 5D.
W87-05576

USING SOIL MORPHOLOGY TO DEVELOP MEASUREMENT METHODS AND SIMULATION TECHNIQUES FOR WATER MOVEMENT IN HEAVY CLAY SOILS,
Stichting voor Bodemkartering, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W87-05707

NMR MEASUREMENT OF WATER IN CLAY,
Soil Conservation Service, College Park, MD.
R. F. Paetzold, and G. A. Matzkanin.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 316-319, 2 fig, 2 tab.

Descriptors: *Soil water, *Clays, *Nuclear magnetic resonance, *Measuring instruments, Magnetic studies, Data acquisition.

Recent advances in nuclear magnetic resonance (NMR) technology, including improved electronics, emergence of pulsed NMR techniques, improvements in magnet materials and new designs of magnet configurations, have greatly expanded the usefulness of NMR. Once used primarily by chemists to learn about molecular structure, NMR now is receiving considerable attention as a tool for many practical applications. A variety of measurements can be made with NMR. A spectrum of resonance frequencies can be obtained by sweeping through a range of magnetic field strengths while holding the radio-frequency input constant (or vice versa) to give a signal pattern based on the chemical shift caused by local magnetic field variations due to the effects of neighboring atoms. One area where NMR is particularly useful is the measurement and charaterization of water in materials. For this application, free induction decay or spin-echo NMR signals from hydrogen nuclei in the water molecules are sensed and measured. Not only can the amount of water present be determined, but through the use of relaxation characteristics the physical state and local environment of the water molecules can be investigated. The objective of the research reported here was to develop an instrument capable of measuring volumetric soil water content using NMR techniques under field conditions. An NMR instrument was was designed to continuously measure voluemetric water content in the soil surface at ground speeds of up to 15 km/h. The instrument can be used to gather ground trugh data for remote sensing studies. This application requires a method that is relatively accurate, rapid and independent of soil type, organic matter content, texture and clay mineralogy. (See also W87-05665) (Lantz-PTT)
W87-05708

TIME RESPONSE CHARACTERISTICS OF TENSIOMETERS IN HEAVY CLAY SOILS,
Rothamsted Experimental Station, Harpenden (England).
G. D. Towner.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 320-323, 1 fig, 2 tab, 3 ref.

Descriptors: *Soil moisture, *Moisture meters, *Soil moisture meters, *Tensiometers, *Clays, *Soil water, Measuring instruments, Permeability coefficient, Soil properties, Kaolinite, Kimmeridge clay, Soil compaction, Timing.

A tensiometer must necessarily take a finite time to register a change in pore-water pressure. The tensiometer gauge requires an exchange of water with the soil, and the rate of transfer of this water is controlled not only by the conductance of the tensiometer cup but also by the hydraulic conductivity and water capacity of the soil. An experimental demonstration of the influence of different soils (kaolinite, loosely packed Kimmeridge clay, densely packed Kimmeridge clay, and re-packed Kimmeridge clay) on the tensiometer response was conducted. The analysis indicated that the soil properties must be taken into account in selecting suitable devices for use in heavy clay soils. Under natural conditions, the soil will swell and shrink and may become unsaturated. In so far as a time constant can be defined for such conditions, it will be larger than that given by the basic equations governing the response of a tensiometer in a soil. In practice, the available choice of design parameters is limited. Thus, one is probably only able to assess the performance of a possible system for a given purpose or interpret the value of observations. It is therefore recommended that the time constant should always be measured in situ, preferably over the expected water-content range. (See also W87-05665) (Lantz-PTT)
W87-05709

USE OF THE NEUTRON PROBE AND TENSIOMETERS TO MONITOR GRAVITY IRRIGATION IN SOILS OF LOW PERMEABILITY,
Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France).
For primary bibliographic entry see Field 2G.
W87-05712

MEASUREMENT OF SOIL STRUCTURAL PARAMETERS BY IMAGE ANALYSIS,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 8D.
W87-05714

METEOROLOGICAL RESEARCH NEEDS ON FLOODS AND THEIR MITIGATION,
Maryland Univ., College Park. Inst. for Physical Science and Technology.
For primary bibliographic entry see Field 7A.
W87-05717

NEW APPROACHES IN WATER BALANCE COMPUTATIONS,
International Association of Hydrological Sciences.
Proceedings of a Workshop Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics at Hamburg, West Germany, August 1983. IAHS Publication No. 148. International Association of Hydrological Sciences, 2000 Florida Ave, NW, Washington, DC. 1985. Edited by A. Van der Beken, and A. Herrmann. 167 p.

Descriptors: *Hydrologic budget, *Hydrologic models, *Hydrologic data collections, *Symposium, *Mathematical models, Precipitation, Evaporation, Model studies, Mathematical studies, Soil water, Land use, Runoff, Arid zone hydrology, Evapotranspiration, Drought, Groundwater, Isotopic tracers.

Conclusions of the workshop on new approaches in water balance computations are presented. The objectives of water balance computations (wbc) are diverse. Classification of wbc methods should be made according to space and time scales. The precision of the measurement of several terms in the water balance is questioned at all space and time scales. Since the precipitation measurement error is often >10%, all other terms of the water balance may be affected by this term. Discharge measruements of the very big rivers of the world are not precise. Groundwater outflow into the seas is another weak point. At smaller space and time scales, hydrograph separation techniques are still questionable. Good results have been obtained by environmental isotope studies. Progress has been made in the field of evapotranspiration. Promising new methods are eddy correlation and remote sensing. The soil-plant-water system-analysis is a most important calculation method on all space and time scales. Computer models are available for incorporating these calculations in smaller space wbc. Better knowledge of water vapor balances is needed, especially over the oceans. Space and time scales must be decreased for more useful application of computers to hydrological mapping techniques. A well developed hydrological measurement network is important for wbc at all space and time scales. Statistical least squares and linear or nonlinear regression techniques should be used to evaluate the reliability of wbc. Further work is needed on the quality aspects of the wbc. (See also W87-05727 through W87-05740) (Geiger-PTT)
W87-05726

AVAILABILITY OF EVAPORATION DATA IN SPACE AND TIME FOR USE IN WATER BALANCE COMPUTATIONS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W87-05728

APPLICATION OF ENVIRONMENTAL ISOTOPE TECHNIQUES IN WATER BALANCE STUDIES OF SMALL BASINS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
For primary bibliographic entry see Field 2A.
W87-05734

GENERAL REPORT ON GLOBAL, REGIONAL, LOCAL WATER BALANCES AND LONG TERM FORECASTS,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 2A.
W87-05735

SEDIGRAPH AS AN ALTERNATIVE METHOD TO THE PIPET,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W87-05741

DEVELOPMENT OF A TRACE-METAL P61 POINT-INTEGRATING SAMPLER,
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 2J.
W87-05742

EFFECTS OF NOZZLE ORIENTATION ON SEDIMENT SAMPLING,
Geological Survey, St. Paul, MN. Water Resources Div.
T. A. Winterstein, and H. G. Stefan.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-20 to 1-28, 7 fig, 1 tab, 3 ref.

Descriptors: *Water quality, *Sediment sampling, *Suspended sediments, *Nozzles, Quartz, Sand, Particle size, Sampling efficiency, Water sampling, Selective withdrawal, Withdrawal rates, Isokinetics.

A study of the effects of nozzle orientation, withdrawal rate, and particle size on suspended-sediment sampling was made at the Saint Anthony Falls Hydarulics Laboratory, Minneapolis, Minnesota. Three sizes of quartz sand were sampled from a 150 mm-wide recirculating flume with a 6.35 mm I.D. nozzle. Two withdrawal rates (isokinetic and twice-isokinetic) were used to remove the sediment samples from 0.67 m/s flow. Seven nozzle orientations to the flow were used. The sampling efficiency varied with the angel between the nozzle and the flow, the sand size, and the withdrawal rate. The sampling efficiency was higher with the twice-isokinetic withdrawal rate than with the isokinetic withdrawal rate for all nozzle orientations. The sampling efficiency was highest when the 0.06 mm sand was sampled and leaast when the 0.20 mm sand was sampled for all nozzle orientations. As the angle between the nozzle and the flow increased, the sampling efficiency decreased, except when the nozzle mouth was pointing directly downstream. The experimental results indicate that, for quartz sand, the sampling error is negligible if the material is smaller than a critical size, which varies from 0.035 to 0.06 mm. The critical size is a function of the withdrawal rate and the nozzle orientation. (See also W87-05740) (Lantz-PTT)
W87-05743

CONTINUOUS MEASUREMENT OF SUSPENDED-SEDIMENT CONCENTRATION,
Geological Survey, Minneapolis, MN.
For primary bibliographic entry see Field 2J.
W87-05744

INSTRUMENTS FOR MEASURING SUSPENDED SEDIMENT,
Geological Survey, NSTL Station, MS.
For primary bibliographic entry see Field 2J.
W87-05745

SMALL WATERSHED AUTOMATIC WATER QUALITY SAMPLER,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
For primary bibliographic entry see Field 2J.
W87-05746

INNOVATIVE TECHNIQUES FOR COLLECTING HYDROLOGIC DATA,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2E.
W87-05747

SUSPENDED SEDIMENT MONITORED BY SATELLITE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2J.
W87-05748

UNDER WATER MAPPING RIVER CHANNELS AND RESERVOIRS,
Water and Power Resources Service, Denver, CO.
T. J. Randle, and J. O. Blanton.
IN: Proceedings of the Fourth Federal Interagency Sedimentation Conference, March 24-27, 1986, Las Vegas, Nevada. Volume I, 1986. p 1-79 to 1-88, 6 fig, 2 ref.

Descriptors: *Data acquisition, *Channel morphology, *Mapping, *Rivers, *Reservoirs, *Glen Canyon Dam, *Arizona, *El Vado Reservoir, *New Mexico, Channels, Computers, Microwaves, Sonar, Cost analysis.

Collection and analysis of underwater topographic data can be both time consuming and costly. Whether attempting to determine deposition in a reservoir or changes in a river bottom the difficulties in data collection and analysis are the same: Collecting enough data to define a topographic map but not so much as to make field costs prohibitive or overburden the office analysis. This paper describes how this was done by the Bureau of Reclamation at two of itw sites: The Glen Canyon Dam tailrace, in Arizona, and El Vado Reservoir, in New Mexico. The maps were made with the use of an integrated sounding and microwave positioning system and a computer graphics package. The boat's on-board computer determined coordinates and stored the data while in the field. The data were then electronically transferred to the office computer for analysis and map production. (See also W87-05740) (Lantz-PTT)
W87-05749

CESIUM-137 MEASURES EROSION RATE AND SEDIMENT MOVEMENT,
Agricultural Research Service, Durant, OK.
For primary bibliographic entry see Field 2J.
W87-05774

APPLICATION OF 10-BE TO THE STUDY OF EROSION AND SEDIMENT TRANSPORT,
Carnegie Institution of Washington, DC. Dept. of Terrestrial Magnetism.
For primary bibliographic entry see Field 2J.
W87-05775

FACTORS AFFECTING ACCURACY OF BED-LOAD SAMPLING,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W87-05776

RESISTIVITY MEASUREMENTS FOR GROUNDWATER INVESTIGATION IN THE UMM AL-AISH AREA OF NORTHERN KUWAIT,
Kuwait Univ., Safat. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W87-05853

QUANTITATIVE EXTRACTION AND CONCENTRATION OF SYNTHETIC WATER-SOLUBLE ACID DYES FROM AQUEOUS MEDIA USING A QUININE-CHLOROFORM SOLUTION,
Tokyo Coll. of Pharmacy (Japan). Lab. of Drug Metabolism and Toxicology.
P. Kobayashi, N. Ozawa, J. Hanai, M. Isobe, and T. Watabe.
Analytical Chemistry ANCHAM, Vol. 58, No. 14, p 3048-3051, December 1986. 3 fig, 3 tab, 13 ref.

Descriptors: *Sample preparation, *Water analysis, *Extraction, *Synthetic dyes, *Quinine, *Chloroform, *Food colors, Triphenylmethane dyes, Xanthene dyes, Naphtol, Chromatography, Absorptiometry, Carbonated beverages, Spectral analysis.

Twenty-one water-soluble acid dyes, including eleven azo, five triphenylmethane, four xanthene, and one naphthol derivatives, used at practical concentrations for food coloration, were quantitatively extracted from water and various carbonated beverages into a 0.1 M quinine-chloroform solution in the presence of 0.5 M boric acid by brief shaking. Quantitative extraction of these dyes was also accomplished by the 0.1 M quinine-chloroform solution made conveniently from chloroform, quinine hydrochloride, and sodium hydroxide added successively to water or beverages containing boric acid. Quinine acted as a counter cation on the dyes having sulfonic and/or carboxylic acid groups to form chloroform soluble ion-pair complexes. The diacidic base alkaloid interacted with each acid group of mono-, di-, tri-, and tetrasulfonic acid dyes approximately in the ratio 0.8-0.9 to 1. The dyes in the chloroform solution were quantitatively concentrated into a small volume of a sodium hydroxide solution also by brief shaking. The convenient quinine chloroform method was applicable to the quantitative extraction of a mixture of 12 dyes from carbonated beverages, which are all currently used for food coloration. A high pressure liquid chromatographic method is also presented for the systematic separation and determination of these 12 dyes following their concen-

tration into the aqueous alkaline solution. The chromatogram was monitored by double-wavelength absorptiometry in the visible and ultraviolet regions. (Author's abstract)
W87-05881

PRECONCENTRATION OF TRACE ELEMENTS FROM AQUEOUS SOLUTIONS BY OSMOSIS,
Missouri Univ.-Columbia. Dept. of Chemistry.
R. J. Stec, S. R. Koirtyohann, and H. E. Taylor.
Analytical Chemistry ANCHAM, Vol. 58, No. 14, p 3240-3242, December 1986. 2 fig, 4 tab, 3 ref.

Descriptors: *Measuring instruments, *Water analysis, *Trace elements, *Osmosis, *Plasma emission spectrometry, *Permeation rates, Cadmium, Copper, Nickel, Zinc, Manganese, EDTA, Heavy metals, Sample preparation, Chelation, Spectral analysis.

The fabrication, operation, and performance characteristics of an osmotic concentrating apparatus are described. The sample solution was pumped through the inner channels of the concentration cell in a direction countercurrent to a concentrated salt solution by a peristaltic pump. The membrane (cellulose acetate) on each side of the sample channel formed a physical boundary between the salt solution and sample channels. Saturated salt solution was contained in a 25-L constant-temperature bath. Inlet and outlet tubes, a thermometer, and an overhead stirrer were secured through the bath cover. Analyte recovery data were obtained on a multielement inductively coupled plasma emission spectrometer. The surface layer of the membrane contained asymmetric pores in the size range of 5 A. Samples to be concentrated were prepared from Cd, Cu, Mn, Ni, and Zn. Analyte recovery data were obtained by allowing 100 mL samples to make a single pass through the concentration cell and measuring the concentration of the analyte in the collected output. The discharged samples were returned to the sample reservoir and diluted to 100 mL in 2% nitric acid for analysis. Analyte enrichment data for the interfacing of the concentrating cell output to the nebulizer of an ICP were obtained in a similar manner. The stability of the permeation rate was dependent on the concentration of the salt solution, the flow rate of the salt solution, and the temperature. Reproducibility is a reflection of the ability to fix these parameters. When the temperature of the saturated salt solution was raised to 79 C, permeation rates doubled. Complexing the analyte ions with EDTA provides dual mechanism of anion repulsion and size exclusion, which helps prevent loss of the analyte by permeation through the membrane. The ability to vary the rate of sample output from the concentrating cell by varying the rate of sample input gives the system the flexibility needed to interface it with a nebulizer of an ICP. (Main-PTT)
W87-05882

7C. Evaluation, Processing and Publication

QUALITY OF BASEFLOWS AS AN INDEX OF AQUIFER YIELD IN THE BASEMENT COMPLEX AREA OF SOUTH-WESTERN NIGERIA,
Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W87-05272

DIGITAL TERRAIN MODELING OF GEOLOGIC DATA FOR A GROUND-WATER MONITORING PROGRAM,
Alabama Power Co., Birmingham.
R. J. Teal, R. L. Butts, J. L. Mintz, and J. C. Redwine.
Bulletin of the Association of Engineering Geologists AEGBBU, Vol. 23 No. 4, p 435-440, November 1986. 4 fig, 1 ref.

Descriptors: *Groundwater management, *Model studies, *Data processing, *Monitoring, *Planning, *Terrain analysis, *Mapping, *Geology, *Geohydrology, *Groundwater hydrology, *Computer programs, *Geologic mapping, Groundwater, Maps, Hydrologic maps, Water table profiles, Profiles.

Geologists from Southern Company Services, Inc. (Birmingham, AL) have developed groundwater monitoring plans for sites in Florida, using the Map Information Management System (MIMS) from Synercom Technology, Inc. and the Contour Interpolation Package (CIP) from Wild Heerbrugg to define the geology and hydrogeology of the areas. MIMS and CIP were used to generate multiple structure, isopach, and water-table contour maps and geologic cross sections for the areas. Computer-aided geology has the following advantages: (1) it frees the geologist from the mechanics of map preparation, thereby allowing more analysis and problem solving; (2) it frees drafters from hours of tracing and lettering; (3) it provides flexibility in the types and numbers of maps generated; (4) it pinpoints errors in data readily; and (5) it allows quick revisions and updates. These advantages result in a more efficient, cost-effective job. (Author's abstract)
W87-05376

USING HOUGH HARMONICS TO VALIDATE AND ASSESS NONLINEAR SHALLOW-WATER MODELS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Matematica.
For primary bibliographic entry see Field 2B.
W87-05391

INTERDISCIPLINARY RESEARCH,
Colorado Univ. at Boulder. Inst. of Behavioral Science.
For primary bibliographic entry see Field 2E.
W87-05725

GENERAL REPORT ON WATER BALANCE COMPUTATION TECHNIQUES,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W87-05730

GENERAL REPORT ON GLOBAL, REGIONAL, LOCAL WATER BALANCES AND LONG TERM FORECASTS,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 2A.
W87-05735

WATER BALANCE APPROACH TO THE STUDY OF ARIDITY AND DROUGHTS WITH SPECIAL REFERENCE TO INDIA,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
For primary bibliographic entry see Field 2A.
W87-05736

SYNOPTIC WATER BALANCE MAPPING IN SWEDEN,
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
For primary bibliographic entry see Field 2A.
W87-05737

SEDIMENT TRANSPORT IN THE BLUE CREEK WATERSHED,
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 2J.
W87-05751

DRAINAGE DENSITY VERSUS RUNOFF AND SEDIMENT YIELD,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2E.
W87-05760

VERIFICATION OF SEDIMENT TRANSPORT FUNCTIONS,
George Washington Univ., Washington, DC.
For primary bibliographic entry see Field 2J.
W87-05792

PHOTOGRAMMETRIC ANALYSIS OF CHANNEL ADJUSTMENT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2J.
W87-05793

SEDIMENT ROUTING-AN ELECTRONIC SPREADSHEET TEMPLATE,
Soil Conservation Service, Davis, CO.
For primary bibliographic entry see Field 2J.
W87-05811

SPATIAL APPROACH TO ESTIMATION OF MISSING DATA,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
M. Ben-Zvi, and S. Kealer.
Journal of Hydrology JHYDA7, Vol. 88, No. 1/2, p 69-78, November 1986. 3 fig, 4 tab, 6 ref.

Descriptors: *Estimating equations, *Data interpretation, *Hydrologic data collections, *Statistics, *Mathematical studies, *Spatial distribution, *Israel, Data collections, Hydrologic models, Networks.

Frequently a hydrologic network exists and the analysis of the collected data is based upon the assumption that the schedule is fully followed. In practice, this is very seldom the case as many factors are involved in the process of data collection, and therefore misleading conclusions may be arrived at. To obviate this the missing data must be estimated on the basis of the observations in the present and the past. A special but frequently encountered case is addressed: at each site a sufficiently long record of observations exists and the phenomenon is characterized by a spatial configuration that moves parallel to itself in time. For such a case an extremely simple method is proposed which enables one to estimate the missing data and the standard error of the estimate. Should this error be too large spatial correlations may be employed to improve the estimates. The method is illustrated on the case of a groundwater network in the coastal aquifer of Israel. (Author's abstract)
W87-05846

8. ENGINEERING WORKS

8A. Structures

CONSTRUCTION AND PERFORMANCE OF RIVER BANK EROSION PROTECTION STRUCTURE IN THE NIGER DELTA,
Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Inst. of Flood and Erosion Control.
For primary bibliographic entry see Field 4D.
W87-05377

GROUTING A SAND DAM,
Illinois Univ. at Chicago Circle.
M. L. Silver, P. S. Fisk, and A. L. Greenman.
Civil Engineering CEWRA9, Vol. 56, No. 12, p 34-36, December 1986. 2 fig.

Descriptors: *Grouting, *Earth dams, *Embankments, *Dams, *Maintenance, *Dam construction, *Civil engineering, Radar, Earthworks, Construction, Geophysics, Dam stability, Engineering, Hydroelectric plants, Powerplants, Hardy Dam, Michigan.

Last September, the Hardy Dam, located on the Muskegon River 36 miles north of Grand Rapids, Michigan, successfully withstood one of the area's worst floods in years. This event occurred only weeks after 3,700 cu ft of grout had been used to fill 124 voids in its sand embankment. The voids, which were discovered by accident, had resulted from the rotting out of wooden trestle members left in place during the dam's construction in 1929.

Although a number of remedial measures were considered, grouting at very low pressures was the method of choice, since it would not disturb intact soil. The grouting procedure is described, along with the geophysical methods of investigation and monitoring that were employed. (Doria-PTT)
W87-05384

GRAVITY SANITARY SEWER DESIGN AND CONSTRUCTION.
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 5D.
W87-05400

FLOW IN SIDE WEIRS (L'ECOULEMENT DANS DES DEVERSOIRS LATERAUX),
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Rural et Geometre.
For primary bibliographic entry see Field 8B.
W87-05464

CONSTRUCTION OF THE OPINACA SPILLWAY (CONSTRUCTION DE L'EVACUATEUR DE CRUES OPINACA),
Moncton Univ. (New Brunswick). Ecole de Genie.
M. Massiera, and C. Pelchat.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 5, p 558-568, October 1986. 7 fig, 1 tab, 7 ref.

Descriptors: *Spillways, *Hydraulic structures, *Rock excavation, *Excavation, *Concretes, *Construction, *Opinaca spillway, Grouting, Quality control, James Bay, Quebec, Hydroelectric plants, Hydroelectric power production.

The Opinaca spillway is one of the concrete structures of the EOL (Eastmain - Opinaca - La Grande) project within the 'La Grande' hydroelectric complex at James Bay, Quebec. Three rivers were diverted to the La Grande River to increase the hydroelectric potential of the LG2 power plant. Opinaca spillway is a reinforced concrete structure 28.7 m wide and 46.6. m long with intake and restitution channels excavated in the rock. The different construction phases were described with emphasis on rock excavation and support, grouting, concreting and quality control. (Author's abstract)
W87-05468

EVALUATION OF THE EROSION IN A VALLEY UNDER DAM BREAK FLOWS (COMMENT EVALUER L'EROSION D'UNE VALLEE SOUS L'ECOULEMENT DE RUPTURE D'UN BARRAGE),
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 2J.
W87-05473

REMEDIAL WORKS TO DAER RESERVOIR DAM AND ASSOCIATED STRUCTURES,
Strathclyde Regional Council, Glasgow (Scotland). Water Dept.
D. I. Little, G. F. Brewster, and A. R. Peacock.
Journal of the Institution of Water Engineers and Scientists JIWSDI, Vol. 40, No. 5, p 454-472, October 1986. 6 fig.

Descriptors: *Reservoirs, *Daer Water Supply Scheme, *Dam construction, *Inlets, *Slope protection, *Spillways, Scotland, Berms, Dam stability, Water supply systems.

Improvements and additions to the headworks of the Daer Water Supply Scheme (Scotland) made over 28 yr of operation and currently in progress are described. The reservoir and the circumstances necessitating improvements are outlined, and the following projects are described: replacement of protective slabbing on the upstream face of the dam, augmenting the scour capacity of the reservoir, temporary pumping scheme and raising of the inlet main at spillway crossing, replacement of the berm drain, and design and reconstruction of the spillway. The replacement of the upstream slope protection has now been in place for 6 yr and shows no signs of significant movement or deterioration and the spillway works completed to date have yet to be subjected to a significant overflow. Investigations of the embankment have shown no significant movement of the embankment and no significant leakage. (Rochester-PTT)
W87-05563

ALLUVIAL TRENDS: NOTCHED RIVER CONTROL STRUCTURES,
Corps of Engineers, Omaha, NE.
For primary bibliographic entry see Field 4A.
W87-05803

MODEL STUDY OF TIDAL BARRAGE SLUICES FOR MINIMUM ENERGY LOSS,
Bristol Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W87-05856

FLEXURAL SHEAR FAILURE OF REINFORCED CONCRETE SLAB BRIDGES,
Liverpool Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8F.
W87-05864

BURSTING STRESSES DUE TO PRESTRESSING TENDONS IN CURVED DUCTS,
For primary bibliographic entry see Field 8F.
W87-05866

8B. Hydraulics

CALCULATION OF WAVE-INDUCED TURBULENT FLOWS IN ESTUARIES,
For primary bibliographic entry see Field 2L.
W87-05319

FLOW IN SIDE WEIRS (L'ECOULEMENT DANS DES DEVERSOIRS LATERAUX),
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Rural et Geometre.
W. H. Hager.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 5, p 501-509, October 1986. 8 fig, 2 tab, 17 ref.

Descriptors: *Weirs, *Flow discharge, *Hydraulics, *Open-channel flow, *Flow, Hydraulic design, Hydraulic engineering, Hydraulic structures, Dynamics, Mathematical equations, Mathematical studies, Friction, Free surfaces, Graphical methods, Graphical analysis.

The main flow characteristics of side weirs are presented. Dynamic effects on the lateral outflow intensity and the additional head losses due to the lateral and the frictional effects on the free surface profile are discussed. The pseudouniform flow condition is considered in detail. Using typical nondimensional parameters, the general solution for the free surface profiles and the local discharge distribution is presented graphically. The computational procedure is illustrated by examples. (Author's abstract)
W87-05464

FORM DRAG RESISTANCE OF TWO-DIMENSIONAL STEPPED STEEP OPEN CHANNELS,
King Faisal Univ., Al-Hasa (Saudi Arabia). Water Studies Inst.
A. M. El Khashab.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 5, p 523-527, October 1986. 7 fig, 12 ref.

Descriptors: *Mathematical studies, *Drag, *Open-channel flow, *Flow, Streams, *Weirs, *Steps, *Erosion, Scour, Channel morphology, Roughness, Flow control, Flow resistance, Mathematical equations, Froude number.

Flow in rough steep open channels is mostly found in mountain streams and in flow overtopping protected weirs. In both cases, the energy of the flowing stream may be dissipated by artificial means so that the flowing water does not result in serious damage due to scour or erosion downstream of the main slope. The best way of achieving this purpose is to lead the flow over a series of steps. The form drag of stepped steep open channels was determined considering the steps as two-dimensional triangular roughness elements. (Author's abstract)
W87-05467

STRUCTURE OF ARTIFICIALLY GENERATED WATER WAVE TRAINS,
Stanford Univ., CA. Dept. of Civil Engineering.
Y. A. Papadimitrakis.
Journal of Geophysical Research (C) JGRCEY, Vol. 91, No. 12, p 14237-14249, December 1986. 7 fig, 5 tab, 64 ref, 2 append. NSF Grant NSF-CEE-7817618.

Descriptors: *Wave height, *Wave propagation, *Wind, *Artificial watercourses, Mathematical analysis, Advection, Drift.

The structure of an artificially generated, sinusoidal water wave train of fixed frequency is examined under the influence of wind. The characteristics of this wave train were obtained with the aid of capacitance-type wave height gauges in a wind wave research facility. Experimental results are given for seven wind speeds in the range 140-400 cm/sec and 1-Hz, 2.54-cm (nominal) amplitude, artificially-generated waves. The amplitude and phase of the various wave components were deduced by a simple method utilizing their traveling wave property and their characteristic dependence upon the streamwise position in the channel. The dispersion relation and component phase speeds were also examined. It was found that (1) the amplitude of the forced and free-traveling second harmonics compares favorably with existing theories and (2) the nonlinearities of the primary wave, the interaction between short gravity waves and the primary waves, and the advection effects of wind drift are mainly responsible for the deviation of the measured phase speeds from the linear theory. The latter results are consistent with the field measurements of Ramamonijiarisoa and Giovanangeli, indicating that the apparent phase speeds at high frequencies are independent of the frequency. The measured phase speeds also increased with wind speed, at a given frequency, in accord with previous laboratory measurements and theoretical computations. (Author's abstract)
W87-05556

JET BEHAVIOUR IN SHALLOW RECEIVING WATER,
James Cook Univ. of North Queensland, Townsville (Australia).
A. J. Johnston, and A. R. Halliwell.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 81, Part 21, p 549-568, December 1986. 11 fig, 18 ref.

Descriptors: *Outfalls, *Jets, *Hydraulic models, *Mixing, *Model studies, *Hydrodynamics, *Path of pollutants, Non-buoyant jet, Buoyant round jet, Current meters, Water depth, Vortices, Graphs, Waste disposal, Discharge.

Two outfall situations common in practice, the non-buoyant slot jet and buoyant round jet, were studied using physical model facilities. Hot-film anemometry in the first case, and a system of thermistors in the second, were used to quantify the various mixing processes. In both situations the mixing characteristics (e.g., the jet center-line location, the center-line velocity, or the lateral spread rates) are, in many circumstances, significantly different from those of the free (deep-water) jet. An interesting phenomenon of being able to flick the non-buoyant slot jet from one boundary to another at one receiving water depth is described quantitatively. The slot jet investigation clearly illustrates that, in addition to jet entrainment, the physical effect of induced vortex action is important and is responsible, in part, for the particular jet behavior in shallow receiving water conditions. These ef-

fects are evident also in the buoyant round jet where, again, the mixing patterns sometimes suggest that an induced vortex is in action. Non-dimensional graphs are presented to quantify the mixing characteristics of jet development. (Author's abstract)
W87-05567

MATHEMATICAL MODEL STUDY OF TIDAL CIRCULATION IN TOLO HARBOUR, HONG KONG: DEVELOPMENT AND VERIFICATION OF A SEMI-IMPLICIT FINITE ELEMENT SCHEME,
Hong Kong Univ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W87-05568

LOCAL SCOUR CAUSED BY SUBMERGED WALL JETS,
Liverpool Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W87-05569

HYDRAULIC STUDIES AND CLEANING EVALUATIONS OF ULTRAVIOLET DISINFECTION UNITS,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W87-05607

MODEL STUDY OF TIDAL BARRAGE SLUICES FOR MINIMUM ENERGY LOSS,
Bristol Univ. (England). Dept. of Civil Engineering.
C. I. Robertson, and R. H. J. Sellin.
Journal of Hydraulic Research JHYRAF, Vol. 23, No. 5, p 453-466, 1985. 13 fig, 8 ref. DEO Contract E/5A/CON/4027/51/085.

Descriptors: *Model studies, *Performance evaluation, *Sluices, *Tidal energy, *Tidal hydraulics, *Tidal powerplants, Energy, Diffusers.

As part of the pre-feasibility study for the Severn Barrage, hydraulic tests were carried out on half models of three sluice passageway designs based on a vertical gated Venturi passage. Froude law scaling relationships were used throughout and the models were tested over a range of water levels corresponding to the expected sea level variation at the preferred barrage site. The sluices were tested under simulated in-service conditions, the flow being in one direction only, i.e. from the open sea. The quantitative results are presented as diffuser efficiency values. Flow visualization identified regions of flow separation and measurements were also made of the downstream velocity distribution in a vertical plane. The three models tested here represent progressive modification and improvement of the original design and their performance, as represented by diffuser efficiency, was improved from 0.55 to 0.75 and finally 0.85. (Authors' abstract)
W87-05856

PROGRESSIVE GATE-MODELLING FOR STUDIES OF FLOW-INDUCED VIBRATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W87-05862

8C. Hydraulic Machinery

OPTIMIZATION OF THE ELIMINATION TURBIDITY FROM WATER BY FLOCCULATION IN A CASCADE OF TWO STIRRED REACTORS (OPTIMIERUNG DER TRUBSTOFFREDUZIERUNG DURCH FLOKKULATION IN EINER ZWEISTUFIGEN RUHRREAKTORKASKADE),
For primary bibliographic entry see Field 5F.
W87-05458

ENGINE EFFICIENCIES IN IRRIGATION PUMPING FROM WELLS,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
A. D. Schneider, and L. L. New.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 4, p 1043-1046, July-August 1986. 4 fig, 3 tab, 7 ref.

Descriptors: *Performance evaluation, *Pump engines, *Efficiency tests, *Field tests, *Irrigation, Pumping, Wells, Engines, Texas High Plains.

Two hundred forty natural gas-powered engines and 26 diesel engines were efficiency tested on irrigation pumping plants in the Texas High Plains. Average thermal efficiencies for the natural gas-powered and diesel engines were 20.5 and 31.2%, respectively. Individual natural gas-powered engines ranged from 7.8 to 28.9% efficiency with industrial type engines designed for gaseous fuel being the most efficient. The range of diesel engine efficiency was much narrower, 26.0 to 34.8%, and for all diesel models tested, one or more engines exceeded 30% efficiency. Engines that tested more efficiently in the laboratory according to manufacturers literature consistently tested more efficiently in the field. (Author's abstract)
W87-05533

OSCILLATING PRESSURE FOR IMPROVING APPLICATION UNIFORMITY OF SPRAY EMITTERS,
California Univ., Davis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W87-05538

PLANT RECYCLES PROCESS AND HYDRAULIC ENERGY,
Metro Wastewater, San Diego, CA.
For primary bibliographic entry see Field 5D.
W87-05573

AIR DRIVE ROTATING BIOLOGICAL CONTACTORS-PROBLEMS ENCOUNTERED AND SOLUTIONS SOUGHT: PART I,
West Virginia Univ., Morgantown. Dept. of Physics.
For primary bibliographic entry see Field 5D.
W87-05581

AVOIDING FINE BUBBLE BREAKDOWN,
Houck (D.H.) Associates, Inc., Silver Spring, MD.
For primary bibliographic entry see Field 5D.
W87-05610

TURBINE-PUMP SYSTEM FOR LOW-HEAD HYDROPOWER,
Cairo Univ., Giza (Egypt). Dept. of Mechanical Engineering.
R. R. Mankbadi, and S. A. Mikhail.
Energy Conversion and Management ECMADL, Vol. 25, No. 3, p 339-344, 1985. 11 fig, 3 ref. Supreme Council of Egyptian Universities Grant 81013.

Descriptors: *Hydraulic machinery, *Turbine-pump system, *Turbines, *Pumps, *Energy conversion, *Hydraulic equipment, Irrigation, Pumping, Domestic water, Mathematical studies, Mathematical equations, Design criteria, Design standards.

Several hydro-energy conversion systems are considered for using low-head hydro including the turbine-pump system installed across irrigation structures. The available low-head energy is used to drive a turbine connected to a pump to lift water for irrigation or domestic purposes. The equations governing the operation of the system were presented. For a given regulator's characteristics, a method is presented for determining the main design parameters of the system. Off-design performance of the system should thus be controlled to achieve maximum pumped flow all year. The turbine-pump system should thus be considered wherever low-head power is available and there is a demand for water to be pumped at a higher head. (Author's abstract)
W87-05616

PROGRESSIVE GATE-MODELLING FOR STUDIES OF FLOW-INDUCED VIBRATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
J. D. Hardwick.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 79, Part 2, p 483-509, September 1985. 25 fig, 1 tab, 15 ref, 2 append.

Descriptors: *Model studies, Gates, *Hydraulic models, *Flow around objects, *Obstruction to flow, *Vibrations, *Tidal surges, *Radial gates, River Scheldt, Belgium.

The River Scheldt in Belgium is increasingly subject to tidal surges caused by storms in the North Sea, and serious flooding threatens low-lying areas for 100 km upstream. One proposed configuration for a flood barrier consisted of three 80 m span drop gates across the navigation channel flanked by radial gates of 50 m span. In the event of a tidal surge, the 50 m gates would regulate the flow until the 80 m gates, on pier towers, could be lowered to their closed position. Thereafter the radial gates would be lowered further to sustain a rising water-level on the sea side relative to the land side. The radial gates could also open during an emergency both at the height of a surge tide and at ebb tide between surges when flow would be reversed. A model study of flow-induced vibration of the 50 m gates was considered essential in view of the long span of these gates and their box girder construction. A progressive modelling technique was used, involving two preliminary, part-span models before construction of the final, full span model. Variations in design were explored in the preliminary stages, thus reducing the need to modify the large and expensive final model. The prototype gates had an unusually heavy duty and were designed without seals, but the predicted levels of vibrations indicated no threat to the stability or operation of the gates. The complimentary models provided a deeper understanding of the interaction between a structure and the surrounding flow. Flooding and draining holes in a gate had a marked influence on the natural frequency and damping. An empirical relationship was developed between the vibration response of a gate and the power dissipated in the stilling pool. (McFarlane-PTT)
W87-05862

8D. Soil Mechanics

GROUTING A SAND DAM,
Illinois Univ. at Chicago Circle.
For primary bibliographic entry see Field 8A.
W87-05384

WICKING BAY MUD,
Brian, Kangas, Foulk and Associates, Redwood City, CA.
M. Keech.
Civil Engineering CEWRA9, Vol. 56, No. 12, p 53-55, December 1986. 1 fig.

Descriptors: *Mud, *Drains, *Wick drains, *Construction, *Civil engineering, *Bays, Engineering, Excavation, Costs, Construction costs, Soil engineering.

A 65-acre site four miles east of the San Andreas fault in Redwood City, CA is currently being readied for the construction of an office complex. Construction is complicated by the presence of soft, compressible bay muds. Future settlements of three feet were predicted in the fill areas, and extensive boundary conditions between previously consolidated and unconsolidated fill areas were cause for concern. Therefore, contractors have designed a wick drain and surcharging system, to be installed in three phases over two years. In the first two phases, a system of wick drains, subterranean drainage and pumping together with surcharging will remove 8.5 million gallons of mud-entrapped water. By reusing the same soil for the three surcharge phases, import requirements will

be reduced by 75%. Total settlement induced by surcharging was 80% of the site's expected 50-year settlement. The construction and installation operations are described, and cost figures are provided. (Doria-PTT)
W87-05385

CUT-AND-FILL BECOMES CUT-AND-DRAIN,
C. K. Coles, and K. Shirata.
Civil Engineering CEWRA9, Vol. 56, No. 12, p 64-65, December 1986. 2 fig.

Descriptors: *Drains, *Philippines, *Civil engineering, *Construction, *Excavation, Engineering, Soil engineering. Subsurface drains, Channels, Erosion control, Protection, Shore protection.

The U.S. Navy is cutting a slope at the Naval Air Station Cubi Point in the Philippines in order to construct a new maintenance hangar, office building, and aircraft parking apron. The operation will require 700,000 cu yd of excavation, using the soil as shoreside fill. The slope was specifically designed to mitigate the hazards posed by torrential rains and seepage, including landslides, deep mud deposits, and settlements due to seepage and tidal action. An elaborate drainage system was required to keep the groundwater at least 20 ft below the cut. Surface drainage consists of two or three rows of shallow concrete chevron drains on each slope face. The subsurface drainage system consists of deep trench drains at the bottom of each slope and 1-1/2 inch horizontal drains drilled into the slope. The construction sequence of these drains is described. (Author's abstract)
W87-05387

SLOPE INDICATOR MEASUREMENTS OF SUBSURFACE MOVEMENT IN GULLY WALLS,
Royal Tropical Inst., Amsterdam (Netherlands).
For primary bibliographic entry see Field 2J.
W87-05524

DEVELOPMENT OF STRUCTURAL AND MICROFABRIC PROPERTIES IN SHRINKING AND SWELLING CLAYS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
L. P. Wilding, and C. T. Hallmark.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 1-22, 4 fig, 54 ref.

Descriptors: *Soil water, *Clays, *Soil moisture retention, *Soil swelling, *Soil shrinking, *Soil structure, Carbonates, Chemical properties, Bonding, Cohesion, Lattices.

Soil structure in the pedological context is the physical constitution of soil material expressed by size, shape and arrangement of solid particles and voids into secondary polyhedral assemblages of primary particles. The secondary units (peds) are separated from adjoining cohesive aggregates by natural surfaces of weakness. Surfaces of weakness include simple or compound concentration coatings (cutans) of sesquioxides, clays, organic-clay complexes, carbonates, albic materials, and/or rearrangement of in situ clay plasma by stress. In high shrink-swell clay systems, structural surfaces are commonly generated by microshear, macroshear (slickensides), or plastic deformation stresses. Microfabrics are lattisepic, vosepic, masepic, skelsepic and crystic. Several generations of structural formation and subsequent instability are evident from microfabric analysis. Size of structural units is generally smallest near the surface and increases with depth while strength of structural development is the reverse. While cutanic surface features may comprise only a small proportion of the ped bulk volume, their impact on inter- and intra-ped solute and water transfer may be inordinately great. Structural units are stabilized by interparticle bonding associated with organic matter, amorphous inorganic compounds, and silicate clays. Bonding forces include polar and non-polar van der Waal forces, coulombic attractions, and organic chelation - complexation of polyvalent metals at silicate surfaces. (See also W87-05665) (Author's abstract)
W87-05666

MECHANICS OF CRACKING SOILS,
Institute for Soil Fertility, Haren (Netherlands).
P. A. C. Raats.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 23-38, 5 fig, 29 ref.

Descriptors: *Soil mechanics, *Soil cracking, *Soil shrinking, *Soil swelling, *Mathematical studies, Stress, Mathematical analysis, Drying.

The deformation gradient tensor of the solid phase of a soil is the central concept in the description of swelling and shrinkage of soils. The appearance of slip surfaces and cracks is governed by relationships among the stress tensor and parameters characterizing the strength of the soil. An analysis of the perturbation of stress induced by a crack gives some insight in spacings, angles of intersection, and depths of cracks. The use of mathematical techniques to study this perturbation of stress is presented. (See also W87-05665) (Author's abstract)
W87-05667

MECHANICS OF COLLOIDAL SUSPENSIONS WITH APPLICATION TO STRESS TRANSMISSION, VOLUME CHANGE, AND CRACKING IN CLAY SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip, J. H. Knight, and J. J. Mahony.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 39-44, 5 ref.

Descriptors: *Colloidal suspensions, *Stress transmission, *Clays, *Soil mechanics, Soil cracking, Soil volume, Soil moisture, Soil properties, Mathematical studies, Poisson-Boltzmann equation, Mathematical analysis, Drying.

Work in progress on the mechanics of colloidal suspensions promises to furnish new insights into various elements of the mechanics of heavy clay soils. Various aspects were studied, such as: the state of stress of the water in heavy clay soils; stress tensors and stress trajectories on both microscopic and macroscopic scales; one-dimensional, three-dimensional, and other modes of soil volume change and deformation; and the energetics of soil cracking. Although a heavy clay soil is not simply a dense colloidal suspension, the latter offers a more physically meaningful point of departure for the study of the mechanics of such soils than does the classical elastic body, which is the starting point of conventional soil mechanics. This study is an investigation of electrical double-layer interactions in homogeneous swarms of charged particles, based on the Poisson-Boltzmann equation. Recognized are the simplifications, omissions, and limitations of the model, but the essential elements of the problems are addressed. Many limitations will be removable by later, more elaborate, calculations. (See also W87-05665) (Lantz-PTT)
W87-05668

EXTENT AND DYNAMICS OF CRACKING IN A HEAVY CLAY SOIL WITH XERIC MOISTURE REGIME,
Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
D. H. Yaalon, and D. Kalmar.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 45-48, 2 fig, 5 ref.

Descriptors: *Clays, *Infiltration, *Soil mechanics, *Soil moisture, *Zevulon, *Israel, Soil moisture deficiency, Soil cracking, Grumosols, Soil shrinking, Soil properties, Regression analysis, Mathematical studies, Drying.

Cracks increase the rate at which a pedon can accept and absorb moisture during the wetting process, and their extent and dynamics are of interest in structure development and in water transport studies. For two seasons, the development of cracking on a bare, weakly calcareous, alluvial Grumosol (Typic Pelloxerert), in the Zevulon valley, Israel, has been studied. Measurements of surface cracking were made along a tape 20 m by 20 m and their depth was measured with a thin wire probe. The first shrinkage cracks appeared 30 days after the last rain and some reached a maximum width of 9.5 cm. Width of most cracks increased with time to a mean width of 3.5 cm. Median distance between cracks decrased from over 50 cm to less than 20 cm, indicating that pattern development took about 150 days. No new cracks formed after this, remaining at a mean density of 3.3 cracks/linear meter. Maximum depth reached by the cracks measured was 80 cm, but most cracks did not extend beyond 40 cm. Spatial distribution of the cracks with time indicates that only once did upper soil material fall into deeper layers. The volume was only 0.05% of the total soil volume; in the preceding season the volume was 0.1%. It was not possible to ascertain whether surface cracks re-establish themselves at a similar pattern during the next drying season, but micromorphological evidence from deeper layers suggests that to some extent it does develop the same rupture faces. Deep seasonal cracking is important for the development of strong and stable soil structure. Previous measurements indicate that in well structured Israeli Grumusols (Vertisols) the steady state infiltration rate is five or more mm/h after 40-50 mm of rainfall. It decreases significantly on a distrubed or irrigated soil not allowed to dry out. (See also W87-05665) (Lantz-PTT)
W87-05669

EVOLUTION OF CRACK NETWORKS DURING SHRINKAGE OF A CLAY SOIL UNDER GRASS AND WINTER WHEAT CROPS,
Centre de Recherches d'Avignon, Montfavet (France).
V. Hallaire.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 49-54, 5 fig, 3 ref.

Descriptors: *Clays, *Soil mechanics, *Wheat, *Soil cracking, Soil water, Montmorillonite, Chlorite, Fescue, Soil shrinking, Mathematical studies, Drying.

Pore space characteristics of swelling clay soils are mainly influenced by the soil water content. A dynamic recording of crack size and spacing is required to characterize hydrodynamic properties of these soils. The evolution of crack networks in a drying clay soil was studied for two different crops (grass and winter wheat). The investigated soil (Les Vigneres) is a clayey soil, with a clay fraction (52-56%) consisting mainly of montmorillonite and chlorite. The dry bulk density of the aggregates varies from 1.45 to 1.90 gm/cu cm, corresponding with field capacity (gravimetric water content w = 30%) and shrinkage limit (w = 10%). Three plots were investigated: with winter wheat, with grass (fescue) and without any vegetation. The study of mean values and standard deviations of the cracks void ratio (e sub f), combined with field elevation, showed that: (1) At the end of the winter, the soil was at field capacity (w = about 30%); (2) For 30% > w > 23%, the vertical shrinkage of the whole profile was not important (> 1%). Despite the presence of thin or even invisible cracks, they were detected by bulk density measurements (e sub f reached 0.15); (3) For 23% > w > 18%, vertical shrinkage was larger (up to 4%). The mean value of e sub f reached 0.25 under wheat, and 0.30 under grass. The large standard deviation appeared to indicate a wider crack network. The cracking process seems to be

divided into two stages which are defined by water content. The second stage follows from the evaporative demand: in May for winter wheat, in June for grass. The start of the second stage is associated with the same water content, approximately 23%. (See also W87-05665) (Lantz-PTT)
W87-05670

CRACKING PATTERNS IN SOILS CAUSED BY SHRINKING AND SWELLING,
Hanover Univ. (Germany, F.R.). Inst. fuer Bodenkunde.
For primary bibliographic entry see Field 2G.
W87-05671

CRACK FORMATION IN NEWLY RECLAIMED SEDIMENTS IN THE IJSSELMEER POLDERS,
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
For primary bibliographic entry see Field 2G.
W87-05672

TECHNIQUE FOR THE DESCRIPTION OF THE CRACK PATTERN AND FOR PREDICTING THE HYDRAULIC EFFICIENCY OF HEAVY SOILS,
Design and Construction Inst. of the Czechoslovak Ceramic Industries, Prague.
For primary bibliographic entry see Field 2G.
W87-05673

HYDRAULIC CONDUCTIVITY AND STRUCTURE OF THREE AUSTRALIAN IRRIGATED CLAYS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W87-05681

SEASONAL CHANGES OF HYDRIC AND STRUCTURAL BEHAVIOUR IN CLAY SOILS WITH SALINE WATERTABLES ON THE COAST OF LANGUEDOC, FRANCE,
Centre de Recherches de Montpellier (France).
For primary bibliographic entry see Field 2G.
W87-05689

ROLE OF STRUCTURE FOR THE COMPRESSIBILITY AND TRAFFICABILITY OF HEAVY CLAY SOILS,
Bayreuth Univ. (Germany, F.R.). Abt. Bodenphysik.
R. Horn.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 342-349, 3 fig, 1 tab, 7 ref.

Descriptors: *Clays, *Soil structure, *Soil compressibility, Agriculture, Soil aggregates, Mathematical analysis, Permeability coefficient, Water pressure, Saturated soils, Soil horizons.

Cultivation methods are being evaluated critically because increasing loads of agricultural machinery often induce soil compaction or destruction of the soil structure by kneading under wet conditions, and worsening growing conditions for plants. Such problems are frequent in clayey soils which, because of their high clay content, may be stabilized by swelling and shrinkage. Clay soils may also be sensitive to changes in aggregate stability. This paper presents data on the quantification of the mechanical compressibility of clay soil, because in the literature such data are rare. Different soil samples were investigated as follows: (1) The compression-settlement behavior (load range: 0 - 15 N/sq cm) was measured with respect to changes in water pressure in dependence of time and load were registered. (2) The spatial pressure transmission was measured at different surcharges by strain gages and the concentration factors were determined mathematically. The depth function of the saturated hydraulic conductivity in dependence of the vertical load at the top of the soil, could be calculated by combining the transformed concentration factor equation with the load dependent values of the saturated hydraulic conductivity. While the values of the concentration factor of the mechanically homogenized soil samples were very high even after desiccation at 300 mbar and under small loads, corresponding values for the natural soil samples were much lower. The natural aggregation effect is thus demonstrated as well as the stabilization effect in relation to the dessication rate. Saturated hydraulic conductivity of the mechanically homogenized soil is intensively reduced not only directly below the surface of the compressed and untilled soil horizon, but also in the following 20 to 30 cm. This increase in structural stability leads to higher values in the same depth and to a more intensive pressure compensation. Higher load at the top of the soil horizon induces a further reduction of the saturated hydraulic conductivity in all depths. (See also W87-05665) (Lantz-PTT)
W87-05713

MEASUREMENT OF SOIL STRUCTURAL PARAMETERS BY IMAGE ANALYSIS,
Rothamsted Experimental Station, Harpenden (England).
A. Ringrose-Voase, and P. Bullock.
IN: Proceedings of the ISSS Symposium on Water and Solute Movement in Heavy Clay Soils, International Institute for Land Reclamation and Improvement, The Netherlands. ILRI Publication 37. p 350-356, 2 fig, 1 tab, 7 ref.

Descriptors: *Soil water, *Soil structure, *Imaging, Flow profile, Pore sizze, Model studies, Computers, Quantimet 720, Soil fissures, Soil porosity.

Soil structure is the most important property affecting the storage and movement of water in soils. Modelling water retention and flow in soils requires measurement of pore sizes and arrangements, but until recently neither of these requirements has been obtainable directly. Instead, there has been a dependence on indirect measurements. The currently most satisfactory method of directly measuring pore space seems to be through resin impregnation of undisturbed samples and the measurement of structural properties in the images derived. All stages in this approach have been improved recently: (i) larger samples can be impregnated, giving a more representative volume; (ii) drying by solvent extraction of water reduces the likelihood of artifcats; (iii) more sophisticated photographic techniques enable high quality images to be derived. Results from studies of soil structure using the image analyzing computer Quantimet 720, clearly indicate a difference in structure between wet and dry conditions. Porosity associated with fissures is reduced by 55% in the wet state compared with the dry one. The areal extent of the fissures is reduced by 22% in the wet soil, and there is a reduction of mean fissure width of 42% from 1.08 mm in the dry soil to 0.62 mm in the wet soil. Using image analysis, the proportion of conducting pores, the areal extent of fissures and their mean width in a clay soil at different moisture contents can be obtained. As well as being valuable in monitoring seasonal changes in structure, it can also provide a stronger numerical input into modelling for water movement and retention. (See also W87-05714) (Lantz-PTT)
W87-05714

8E. Rock Mechanics and Geology

REGIONAL HYDROGEOLOGY OF THE EDWARDS AQUIFER, SOUTH CENTRAL TEXAS,
Texas Univ. at El Paso. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W87-05224

FINITE ELEMENT ANALYSIS OF ARCH DAMS IN WIDE VALLEYS INCLUDING THE EFFECT OF CRACK FORMATION AT THE CONCRETE-ROCK INTERFACE,
Department of Water Affairs, Pretoria (South Africa).
J. P. F. O'Conner.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 79, Part 2, p 511-532, September 1985. 16 fig, 14 ref, append.

Descriptors: *Arch dams, *Cracks, *Model studies, *Dam design, *Dam construction, *Dam failure, *Dam foundations, Finite element method.

A study of arch dam profiles in a wide valley concluded that curved dams may be economically and safely constructed in valleys with a width-to-height ratio greater than 5, the commonly accepted upper limit. A method of analyzing arch dams in wide valleys is presented which takes into account the formation of a crack at the concrete-rock interface. A 16 node isoparametric curved surface interface element is embedded in a three-dimensional finite element mesh. The interface elements are most commonly placed along the concrete-rock contact surface but can also be used in other locations, as desired. A variable elasticity process is used to modify the stiffness matrices in the interface elements, while the three-dimensional elements used throughout the mesh represent linear elastic conditions only. As compressive stresses in arch dams are generally low and the non-linear behavior can be attributed to cracking in the concrete due to tensile stresses, for all static load cases, it is felt that the approach of modelling the structure with interface elements at locations where major crack surfaces are likely to appear forms a good basis for design, as well as for checking existing structures. The method presented also includes a check on the solution by the equilibration of forces along the contact surface and the applied loads. Resultant forces output along the contact surface, both for the elastic and the joint analyses, bracket the actual forces that can be expected at the contact surfaces so that limit state analyses can be carried out on the foundation blocks. (Author's abstract)
W87-05863

8F. Concrete

CONSTRUCTION OF THE OPINACA SPILLWAY (CONSTRUCTION DE L'EVACUATEUR DE CRUES OPINACA),
Moncton Univ. (New Brunswick). Ecole de Genie.
For primary bibliographic entry see Field 8A.
W87-05468

FINITE ELEMENT ANALYSIS OF ARCH DAMS IN WIDE VALLEYS INCLUDING THE EFFECT OF CRACK FORMATION AT THE CONCRETE-ROCK INTERFACE,
Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 8E.
W87-05863

FLEXURAL SHEAR FAILURE OF REINFORCED CONCRETE SLAB BRIDGES,
Liverpool Univ. (England). Dept. of Civil Engineering.
R. J. Cope.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 79, Part 2, p 559-583, September 1985. 22 fig, 8 tab, 10 ref.

Descriptors: *Model studies, *Model testing, *Shear tests, *Reinforced concrete, *Slab bridges, Stress.

Design of slab bridges against flexural shear failure is based on test data obtained mainly from beams and one-way spanning slabs. Owing to the concentrated nature of highway bridge loading, the distribution of shear force intensity on a section across a deck is not constant. When the deck has a skew angle, the concentration of shear forces increases considerably, owing to the additional twisting action. Code procedures for designing a slab bridge, and for assessing the strength of existing bridges, use the convenient comparison of calculated average vertical shear 'stresses' on critical sections, with section capacities calculated according

to a simple formula. This paper describes test results producing shear failures in 5 one-fifth scale models of reinforced concrete slab bridges with skews of 30, 45, and 60 degrees. The results show clearly that an increasing angle of skew decreases considerably the shear capacity of a slab. Designs for skews of up to 45 degrees could be based on beam strips and recommendations for suitable section widths are made. Factors affecting shear failure and the interpretation of model results to full-sized structures are discussed. Current design methods are assessed using the test data, and recommendations concerning future practices are made. (McFarlane-PTT)
W87-05864

STUDY OF THE EARLY HYDRATION OF PORTLAND CEMENT,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Civil Engineering.
W. J. McCarter, and A. B. Afshar.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 79, Part 2, p 585-684, September 1985. 10 fig, 31 ref.

Descriptors: *Portland cements, *Hydration, *Cement technology, *Cement testing, Materials testing, Construction materials.

The purposes of this paper were to (1) describe the alternating current response characteristics of cement paste during the early stages of setting and hardening; (2) interpret this response in terms of chemical and structure-building processes; (3) illustrate the influences of admixtures and changes in composition on the electrical response of cement paste; and (4) present a novel electrical response technique for monitoring cement hydration. The response data can be used to monitor the chemical and structure-building processes associated with hydration and used in assessing the influence of additives, cement composition, and environment on these processes. Scanning electron microscopy was used to corroborate predictions about the state of the paste inferred from the electrical response. The method developed has certain advantages over present structure determining techniques in that (1) the fabric structure of the paste is not destroyed; (2) the sample size is sufficiently large to investigate macroscale behavior; and (3) the technique offers an alternative method for continuous monitoring of hydration processes over the initial 24 h after gauging with water. The technique could find wide application, not only for fundamental research into cement hydration, but also as a relatively simple tool in helping the engineer in assessing cement hydration characteristics. (McFarlane-PTT)
W87-05865

BURSTING STRESSES DUE TO PRESTRESSING TENDONS IN CURVED DUCTS,
A. McLeish.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 79, Part 2, p 605-615, September 1985. 8 fig, 2 tab, 4 ref.

Descriptors: *Bridges, *Prestressed concrete, *Design standards, *Beams, Ducts, Stress, Construction materials, Performance evaluation.

Deflected prestressing tendons are commonly used in bridge and slab construction. Whereas the global benefits from using curved prestressing tendons can be evaluated without difficulty, the local effects adjacent to the duct are harder to quantify. The radial force due to a curved tendon induces bursting stresses in the concrete, a problem that is compounded when several tendons run parallel to each other. This research program was aimed at providing sufficient data to support the formulation of new design rules for beams containing curved prestressing tendons. The program addressed (1) finite element analysis of a slice through a beam of varying geometry; (2) loading tests on concrete slices 150 mm thick to support the analysis; and (3) tests on 3 full-size T beams each containing 3 curved tendons. Results from 3 approaches adopted were generally in close agreement. A comparison between the results and existing design guide-lines indicates that for thin sections the guide lines are highly conservative. For thicker sections, however, the resistance to bursting stresses is overestimated. A set of design curves for sections containing up to three ducts is presented and its use illustrated. (Author's abstract)
W87-05866

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

TRAINING OF SANITARY ENGINEERS IN EUROPE.
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5G.
W87-05331

9C. Research Facilities

PUBLIC HEALTH RESEARCH NEEDS,
Epidemiology Research Center, Tampa, FL.
For primary bibliographic entry see Field 2E.
W87-05720

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

WASTEWATER DISINFECTION AND INFECTIOUS DISEASE RISKS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W87-05548

PHYSICAL CHARACTERISTICS OF ACTIVATED SLUDGE FLOCS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-05549

PLANT WATER BALANCE,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
For primary bibliographic entry see Field 2I.
W87-05595

STRESS PHYSIOLOGY AND THE DISTRIBUTION OF PLANTS,
Australian National Univ., Canberra. Dept. of Environmental Biology.
For primary bibliographic entry see Field 2I.
W87-05596

SUBJECT INDEX

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